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NASA-GSFC

STADAN-SPACECRAFT COMPATIBILITY TEST PROCEDURES

DATA SHEETS

NOVEMBER 1969

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

(NASA-TM-X-70571) STADAN-SPACECRAFT COMPATIBILITY TEST PROCEDURES AND DATA SHEETS (NASA) 136 p

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GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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STADAN-SPACECRAFT COMPATIBILITY TEST PROCEDURES AND DATA SHEETS

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INTRODUCTION

SECTION 1
INTRODUCTION

1.1 GENERAL

This document contains a complete set of the test procedures and data sheets used for conducting compatibility tests of the interface between the Space Tracking and Data Acquisition Network (STADAN) and a spacecraft. General information is also presented on the purpose and methods of compatibility testing. This document will be used in conjunction with the applicable Compatibility Test Plan when conducting a test.

Section 2 delineates the change control procedures required to maintain this document in a current status.

Section 3 provides a description of the compatibility tests and explains the grouping and numbering system used to accommodate the wide variety of tests now in use. Each major group of tests is also briefly discussed in this section.

Section 4 contains a complete set of all test procedures and data sheets currently in use. Since these tests are subject to revision as spacecraft technology progresses, document page numbers have not been assigned; however, each test is identified by test number and test-page number, and pages may be changed and tests may be added or removed without disrupting the continuity of the numbering system for the tests. The test equipment configuration required for each compatibility test is presented in the test procedure, with reference to the appropriate compatibility test configuration block diagram of the Compatibility Test Plan for the spacecraft undergoing test. Four of these representative block diagrams are presented in Appendix A.

1.2 PURPOSE OF COMPATIBILITY TESTING

Compatibility tests provide assurance that STADAN tracking, telemetry, and command parameters; equipment; and operational procedures are adequate for the intended mission requirements. In addition, tapes and tape exercise instructions are prepared to aid STADAN personnel in becoming familiar with the operational characteristics of the spacecraft. This familiarity results in better support in acquiring data and readying personnel for meeting contingencies which may arise.

The specific objectives of compatibility testing are:

- To provide the Tracking and Data Systems Directorate advance experience with the spacecraft under controlled conditions.
- To determine spacecraft-to-STADAN tracking, telemetry, and command capabilities and limitations.
- To verify equipment parameters and operating procedures.
- To produce magnetic tapes, strip charts, and other data suitable for verifying that the STADAN outputs are compatible with GSFC data-handling equipment.
- To complete operations procedures and prepare simulation exercises for STADAN and other GSFC organizations.

1.3 METHOD OF TESTING

Compatibility tests are usually conducted at the Network Test and Training Facility (NTTF), Goddard Space Flight Center, Greenbelt, Maryland. At the NTTF, the spacecraft is placed within a shielded enclosure to prevent undesirable electromagnetic interference from affecting the tests. The enclosure outputs are connected to equipment similar to that in a STADAN station. Testing proceeds according to a plan designed to check every aspect of signal transfer between the spacecraft and the STADAN. If the tests disclose that certain circuits of the spacecraft are not performing properly or that the signals do not interface with the STADAN equipment, possible compromises in operational requirements or modifications to the spacecraft are discussed with project representatives.

Although most compatibility testing is conducted at the NTTF, tests may be conducted at other locations. In instances where the compatibility testing is conducted at a site other than the NTTF, the tests are conducted in a van especially configured for test purposes. The test procedures presented in this document apply both to the NTTF and to the STADAN Test Van.

The specific tests required for each spacecraft are outlined in the Compatibility Test Plan prepared by the Network Assurance Section, STADAN Operations Division, Tracking and Data Systems Directorate. Some of these tests may have been previously performed by the spacecraft manufacturer. Where valid data from a test performed, using essentially the same procedures, can be furnished to the Network Assurance Section by the compatibility test date, certain designated tests in the Compatibility Test Plan will be waived. The tests which may be waived are identified by an asterisk, as listed in Section 3, paragraph 3.2

SECTION 2
CHANGE CONTROL AND DISTRIBUTION

SECTION 2

CHANGE CONTROL AND DISTRIBUTION

2.1 CHANGE NOTICE PROCEDURES

The test procedures and data sheets contained in Section 4 of this document will be revised and updated at periodic intervals as directed by the Network Assurance Section (NAS). All requests for changes, deletions, or additions must be submitted to NAS for approval in accordance with the procedures prescribed in this section.

All changes will be issued in the form of a Change Notice package which will consist of the Change Notice, a List of Effective Pages, and the printed pages required. The List of Effective Pages (Figure 2-1) will reflect the level of revision by the addition of a letter following the document number, the issue date of each current page, and the approval signature of the Head, Network Assurance Section. The first change issued will be identified by:

X-531-69-27 (A)

(A) — First Change Notice issued

X-531-69-27 — Original document-identifying number

Each change page included in the Change Notice package will follow the same style and format as the basic document and will be prepared to correct technical errors, to furnish additional pertinent information concerning the test, or to delete information no longer applicable. It will not be originated to correct minor errors unless such errors could lead to faulty test procedures. However, when a page is changed, any existing grammatical or typing errors on the page will be corrected. Each change page will contain the date of the latest change in the upper outside corner.

2.2 INITIATION OF CHANGES

All requests for changes must be submitted to the Network Assurance Section for approval. New tests or corrections to existing tests will be added, upon approval of NAS, as the requirements of the compatibility test program dictate.

A Request for Documentation Change (RDC) form, shown in Figure 2-2, will be generated by the individual determining that the document requires changing. The RDC form will contain the following information:

a. Affected document number

b. Document issue/revision date

c. RDC number (not required)

d. Affected document title

e. Instructions - exact statements as to what and where the change, addition or deletion is and how it should be implemented. Applicable sketches should be included

f. Initiator's name and date

g. Supervisor's approval and date (will be signed by NAS)

h. STADIR or Branch Head approval (no signature necessary)

After an RDC is properly initiated, it is forwarded to the Network Assurance Section, Code 531, for review and approval. When approved, the RDC will be processed and the change notice generated.

2.3 DISTRIBUTION

A Change Notice package will be prepared, processed, and distributed by the Network Assurance Section in the same manner as the original document. Distribution will be accomplished by the Technical Reference Control Facility (TERFAC) in accordance with a standard distribution list provided by NAS.

24 November 1969
(Effective Change Date)

LIST OF EFFECTIVE PAGES

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Page	Issue Date
Title/Approval	Original
iii	(Effective Change Date)
iv thru viii	
1-1 thru 1-3	
2-1 thru 2-4	
3-1 thru 3-6	
A-1 thru A-10	

TEST PROCEDURES AND DATA SHEETS

Test and Page Number	Issue Date
211 -- 1, 2, 4, and 5	Original
211 -- 3	(Effective Change Date)
221 -- 1 thru 2	

(Continue through all tests)

NOTE: The Issue Date column will contain the word "original", or the new Effective Change Date for the pages concerned.

Approved by: (Signature) Head, Network Assurance Section

Approval Date: (Effective Change Date)

Figure 2-1. Format of List of Effective Pages

GODDARD SPACE FLIGHT CENTER

REQUEST FOR DOCUMENTATION CHANGE

AFFECTED DOCUMENT NO.	DOCUMENT ISSUE DATE	RDC NO.

AFFECTED DOCUMENT TITLE

INSTRUCTIONS:

INITIATED BY: DATE	SUPERVISOR APPROVAL: DATE	STADIR OR BRANCH HEAD APPROVAL: DATE
STATION:		

530-155 (2/66)

Figure 2-2. Sample Request for Documentation Change Form

SECTION 3
DESCRIPTION OF COMPATIBILITY TESTS

SECTION 3
DESCRIPTION OF COMPATIBILITY TESTS

3.1 GENERAL

This section contains a complete list of all compatibility tests currently in use. The tests are divided into 9 major groups, numbered 100 through 900, according to the general parameters to be measured. Each major group is subdivided into 9 minor groups, numbered 10 through 90, according to the specific parameters to be measured. Each minor group is further subdivided into a maximum of 9 separate tests to accommodate measurement of the specific parameters. The numbering system has been chosen to accommodate a wide variety of tests now in use and to permit addition or deletion of tests without disrupting the continuity of the numbering system. Each major group of tests is briefly discussed in subsequent paragraphs of this section.

3.1.1 CALIBRATION CHECKS (100 GROUP)

This group consists of STADAN equipment checks made by test personnel prior to using the equipment for a compatibility test. Specific procedural tests and check lists have not been prepared to date, as they are reasonably well defined in other publications pertaining to the equipment being used. Ultimately, procedures for pretest calibration relating specifically to compatibility testing will be developed and included in this group.

3.1.2 SPACECRAFT SIGNAL TESTS (200 GROUP)

This group comprises a series of tests for measuring the more critical spacecraft transmitting parameters. The measurements are of frequency and phase stability, modulation factor, power output, and transmitter transients. A spectrum analysis of the transmitted signal is also performed.

3.1.3 STADAN TELEMETRY EQUIPMENT TESTS (300 GROUP)

This group of tests is for determining whether the modulated signal from the spacecraft will allow correct operation of the phase-lock demodulator, the discriminator, and the data-handling equipment signal conditioner. The threshold, or loss-of-lock point, for each of these equipments is determined for the types of signals generated by the spacecraft under test.

3.1.4 COMMAND EQUIPMENT TESTS (400 GROUP)

This group of command tests is designed to determine if the spacecraft will correctly respond to all correct commands sent with the proper level of modulation. The tests measure the sensitivity of the spacecraft command system with the spacecraft transmitters in both the on and off conditions, the command receiver threshold degradation after exposure to high-input-signal levels, the spacecraft command receiver bandpass, the frequency range of the spacecraft GRARR 4-kHz tone filter bandpass, and how far in error a tone digital command subcarrier or tone sequential address may be and still obtain a response from the spacecraft command system.

3.1.5 COMMAND SECURITY CHECKS (500 GROUP)

The command tests in this group determine if the spacecraft command system will function properly in the presence of a variety of interfering signals and will reject the interference without a response. The interfering signals consist of noise, CW, and AM set to various levels of intensity and sent with different combinations of correct and incorrect commands and frequencies.

3.1.6 RECORDINGS (600 GROUP)

Steady- and variable-level magnetic tapes containing actual telemetry information from the spacecraft are produced as a means of simulating a spacecraft pass. This information is used for determining the compatibility of the spacecraft telemetry signals with data-handling equipment and for conducting simulation exercises at the STADAN stations. Strip chart recordings are made for analysis of the spacecraft telemetry signals, future reference, and comparison analysis after the spacecraft is launched. Photographs are made of the spacecraft demodulated baseband signal for the STADAN stations to compare with signals from the spacecraft during normal pass conditions.

3.1.7 STADAN TRACKING EQUIPMENT TESTS (700 GROUP)

These tests determine if the spacecraft and the Minitrack interferometer system are compatible so that the tracking system can acquire and accurately track the spacecraft. In addition, the Minitrack threshold is determined. Goddard Range and Range Rate (GRARR), or other tracking systems tests, will be included when they are available.

3.1.8 NOT ASSIGNED (800 GROUP)

This series will be assigned at a future date.

3.1.9 MISCELLANEOUS TESTS (900 GROUP)

This group consists of tests devised to obtain compatibility information on spacecraft systems which are not necessarily common to all spacecraft. These tests include the following:

- Tests required by project personnel
- Tests for special or unique equipment
- Tests which do not fall into previously assigned categories

3.2 TEST PROCEDURES AND DATA SHEETS

The test procedures and data sheets are contained in Section 4 of this document. At the back of Section 4 is a remarks page which is included for use with any of the tests when additional remarks are necessary.

The tests listed in this paragraph have been updated as indicated and are current as of the date of this publication. Future updating will be in accordance with the procedures of Section 2. In the complete list of tests provided below, those tests marked with an asterisk (*) will be waived by the Network Assurance Section if valid data are submitted by the time of compatibility testing.

Test No.	Test Title
100 Group	CALIBRATION CHECKS
200 Group	SPACECRAFT SIGNAL TESTS
211*	Frequency Stability and Offset
221	Phase Stability
222	PCM Clock Phase Jitter
230*	RF Spectrum Analysis Summary
231*	RF Spectrum Analysis
232*	RF Spectrum Analysis
233*	RF Spectrum Analysis
243*	Frequency Modulation Deviation
244*	Amplitude Modulation Factor

Test No.	Test Title
245*	Phase Modulation Factor
251*	Power Output
261*	Telemetry Transmitter Transients
300 Group	STADAN TELEMETRY EQUIPMENT TESTS
311	Phase-lock Demodulator Threshold
321	Subcarrier Discriminator Threshold
331	PCM Signal Conditioner Threshold
341	Sync Pulse Amplitude Check
400 Group	COMMAND EQUIPMENT TESTS
411	Command Response to Correct Commands
421*	Zero DBM Test
422*	Command Receiver Sensitivity and Desensitization by Telemetry Transmitter
423*	Command System Modulation Sensitivity
424*	Command Response to Correct Commands at High Signal-to-Noise Ratios
431*	Command Receiver Bandpass
432*	GRARR 4-kHz Tone Filter Bandpass
433*	Command Subcarrier Bandpass
434*	Address Tone Bandpass
500 Group	COMMAND SECURITY CHECKS
511*	Command Receiver Spurious Carrier Immunity
512*	Command Receiver Spurious Modulation Immunity
521*	Command Response to False Addresses
522*	Command Response to Spurious Signals
523*	Command Response of PM Receiver to AM Commands

Test No.	Test Title
600 Group	RECORDINGS
611	Steady-level Magnetic Tape Recordings
612	Variable-level Magnetic Tape Recording
621	Steady-level Strip Chart Recording
631	Baseband Video Photograph
700 Group	STADAN TRACKING EQUIPMENT TESTS
711	Minitrack Compatibility and Threshold
800 Group	NOT ASSIGNED
900 Group	MISCELLANEOUS TESTS

SECTION 4

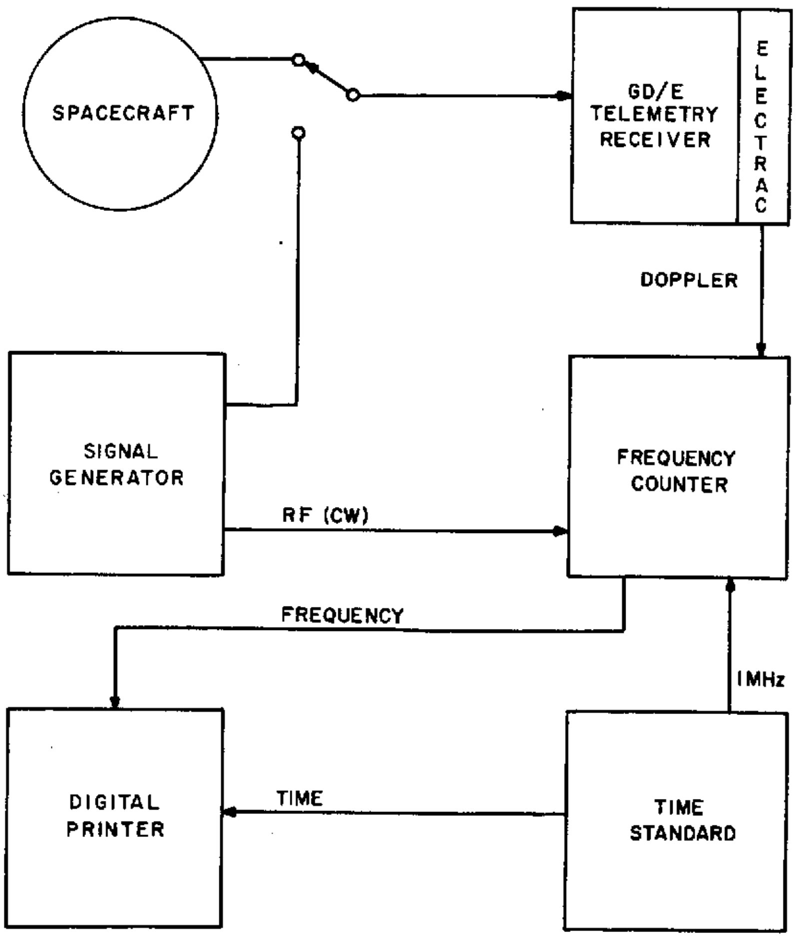
COMPATIBILITY TEST PROCEDURES AND DATA SHEETS

a. Purpose

This test will determine whether the combination of transmitter drift and doppler shift will require readjustment of the STADAN receiving equipment. The total frequency drift plus initial frequency offset should not exceed ± 0.005% of the assigned center frequency over an 8-hour period. No spacecraft mode changes or power source changes are to be made during this test without permission of the test conductor.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

Long-term stability is measured by phase-locking a demodulator to the carrier of the spacecraft signal and monitoring the doppler output jack. Stability will be measured from a cold start, if possible. Calibration of the output frequency is performed before and after the test.

1. Set the signal generator to the spacecraft frequency. With the generator in CW mode, apply the generator output to the telemetry receive system input at a level of -90 dbm. Lock the demodulator to the generator signal.

2. Record the generator frequency (f1) and doppler (fD1) on the data sheet.

3. Apply the spacecraft signal to the telemetry receive system input at a level of -90 dbm. Lock the demodulator to the spacecraft carrier. Start the printer and verify that both time (Z) and doppler (fD2) are printing correctly. Set the counter recycle rate to minimum.

4. After doppler has been printed out for at least two hours, review the data to determine if the spacecraft frequency has drifted more than 0.00125% (1700 Hz at 136 MHz, 5000 Hz at 400 MHz, and 21.2 kHz at 1700 MHz) of the assigned carrier frequency.

5. If the drift is less than or equal to 0.00125%, perform step 7.

6. If the drift is greater than 0.00125%, continue the test for six more hours.

7. Postcalibrate the system by repeating steps 1 and 2.

8. Complete the data sheet and turn it in to the test conductor.

9. The test conductor will plot the spacecraft carrier frequency obtained in step 4 against time.

TEST DATA

Date:	______	Spacecraft:	______
Test Conductor:	______	Model:	______
Test Facility:	______	Spacecraft Location:	______
SOD-NAS Rep:	______	Spacecraft Mode:	______

a. Test Results

1. Precalibration

Frequency standard	f1	______	MHz
Doppler frequency standard	fD1	______	MHz
Doppler correction frequency f1 - fD1 =	fDC	______	MHz
Doppler frequency satellite	fD2	______	MHz
Satellite frequency fDC + fD2 =	f2	______	MHz
Start time		______	Z

2. Postcalibration

Frequency standard	f1	______	MHz
Doppler frequency standard	fD1	______	MHz
Doppler corrective frequency f1 - fD1 =	fDC	______	MHz
Doppler frequency satellite	fD2	______	MHz
Satellite frequency fDC + fD2 =	f2	______	MHz
Stop time		______	Z

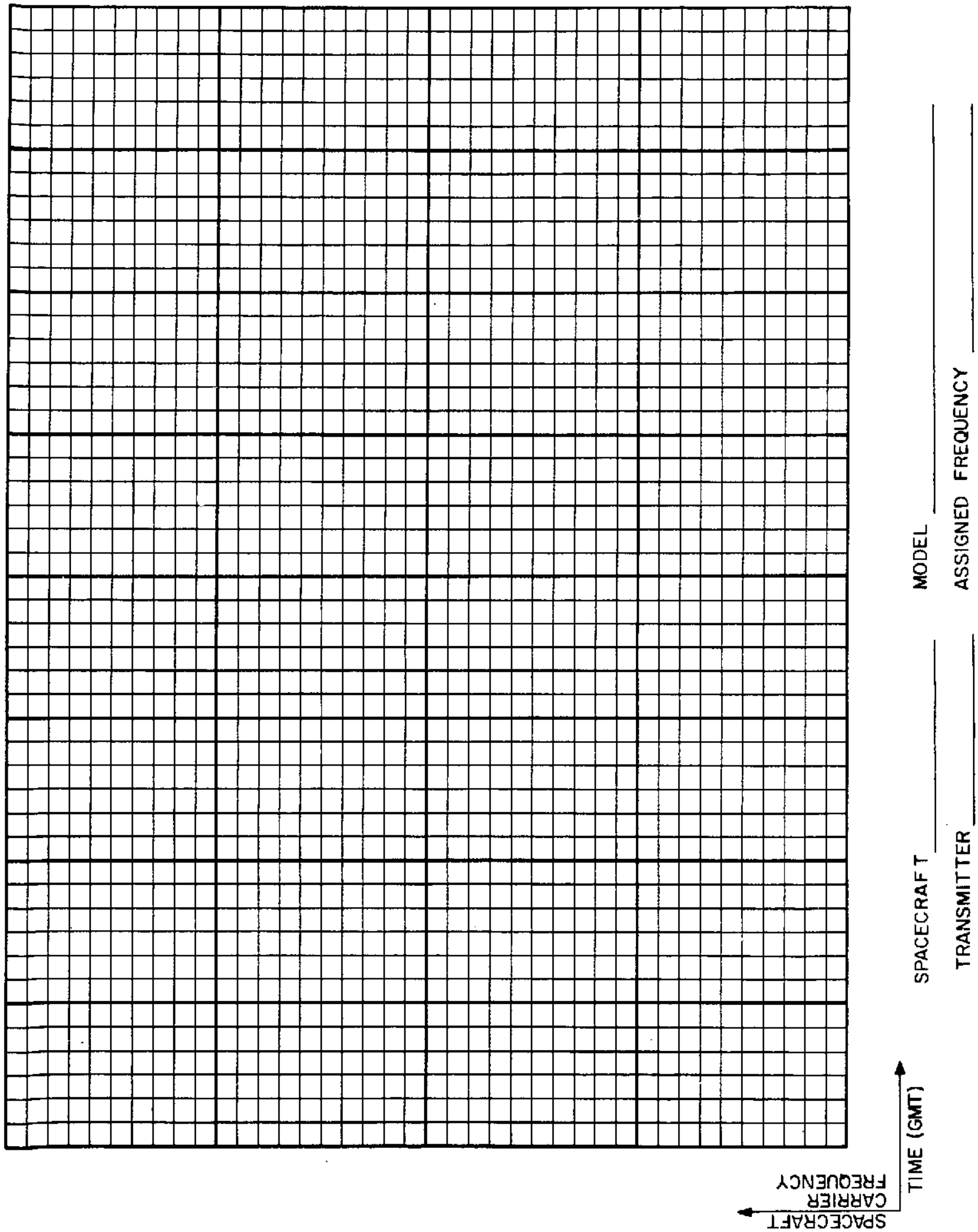
TEST DATA (Cont)

3. Summary

Start time minus stop time (Δt)	____________	Min
Maximum frequency measured	____________	Hz
Minimum frequency measured	____________	Hz
Max. f minus min. f (Δf)	____________	Hz
Max. deviation from assigned frequency	____________	Hz
Indicate whether cold start	Yes____ No____	

b. Remarks

TEST DATA (Cont)



a. Purpose

This test ensures that the spacecraft and demodulator phase variation is low enough (less than 20^{o} peak-to-peak) to allow lock at narrow phase-lock-loop bandwidths.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following exceptions:

1. Demodulator loop bandwidth . . . . 10 Hz
2. Monitor scope bandwidth . . . . 1 Hz

c. Procedure

1 Connect equipment and set the equipment parameters as described above.

2. Lock the phase-lock demodulator to an input signal level of -90 dbm into the preamplifier inputs.

3. Monitor the reference dot on the demodulator oscilloscope for 30 seconds and record the maximum variation observed.

4. If the variations exceed 20^{o} peak-to-peak, increase the bandwidth and repeat step 3, recording the data on the data sheet.

5. Repeat steps 3 and 4 for each data mode available from the transmitter under test.

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Test Results

Spacecraft Mode	Demodulator Loop BW (Hz)	Excursions (degrees)		Peak-to-Peak Excursions (degrees)
		Up	Down	

b. Remarks

____

____

____

____

PCM CLOCK PHASE JITTER

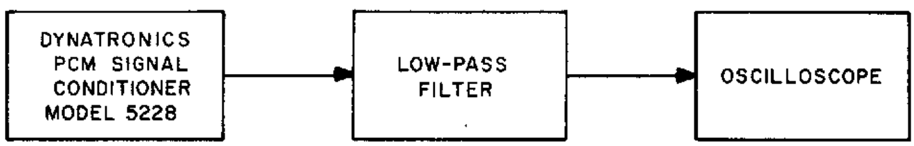
TEST DESCRIPTION

a. Purpose

The purpose of this test is to ensure that the spacecraft PCM clock short-term frequency stability is low enough to allow lock at narrow signal conditioner loop bandwidths.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following exceptions:



c. Procedure

1. Connect the low-pass filter to the phase detector output jack (Pin 12 of card J11) on the PCM signal conditioner. The low-pass filter should be set to 20 Hz or 3% of the bit rate, whichever is greater. Use dc coupling when possible.

2. Set the signal conditioner loop bandwidth to NARROW.

3. Set a square-wave generator to a frequency equal to the bit rate for split-phase signals or to one-half the bit rate for NRZ-type signals. Modulate a calibration generator with the square-wave generator at a modulation factor equal to that assigned to the spacecraft.

4. Set the receiver input level to -90 dbm. Adjust the output of the diversity combiner to 2.8 volts peak-to-peak. Lock the signal conditioner to the square-wave signal.

TEST DESCRIPTION (Cont)

5. Unlock the signal conditioner loop by depressing the lock disable button, keeping the phase detector beat frequency low.

6. Observe the phase detector output on the oscilloscope and adjust the gain of the scope so that full scale deflection is equal to 180 degrees peak-to-peak. Photograph the CRT display.

7. Insert the spacecraft signal in place of the square-wave generator. Lock the signal conditioner and observe the peak-to-peak phase jitter on the calibrated oscilloscope. Photograph the CRT display.

8. Take photographs of a representative sampling of the spacecraft signal. Annotate each photograph with a number, spacecraft mode of operation, filter setting, time axis, and vertical scale calibration.

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Test Results

Photo No.	Spacecraft Mode	Time Base (msec/cm)	Vertical Cal (deg/cm)	Filter Setting (Hz)	Peak-to-Peak Phase Jitter (degrees)

b. Remarks

____

____

____

____

____

TEST DESCRIPTION

a. Purpose

The purpose of the 230 series of tests is to study the energy distribution of the entire RF spectrum emitted by a particular spacecraft transmitter. The spectrum study will be used to indicate whether the RF emissions meet Aerospace Data Systems Standards (NASA-GSFC No. X-560-63-2). In particular these tests will determine if emissions are within the assigned channel bandwidth; if there is excessive carrier suppression; whether or not there is excessive incidental modulation; and the number and type of harmonics and other spurious emissions.

b. Equipment Configuration

Specific equipment connections will vary slightly depending on the spectrum analyzer used. These connections are detailed in the RF Spectrum Analysis Test for the specific equipment being used.

c. Procedure

1. Conduct a spectrum analysis using the appropriate test, or tests, in this series.
2. The test conductor will study the spectrum records and plot the spectrum bandwidth.
3. The spectrum bandwidth, a listing of spurious emissions, and supporting graphic records will be put in the Compatibility Test Report.

TEST DATA

Date: ____________ Spacecraft: ____________

Test Conductor: ____________ Model: ____________

Test Facility: ____________ Spacecraft Location: ____________

SOD-NAS Rep: ____________ Spacecraft Mode: ____________

a. Test Results

1. Type of connection to spacecraft ____ Direct ____ Antenna

2. Number of photographs attached ____________

3. Cable type ____________

4. Cable length ____________

5. Spectrum Analyzer Display Calibration:

Photo or Chart No.	Spacecraft Mode	Photo Center Frequency (MHz)	Analyzer Bandwidth (kHz)	Sweep Rate (sec cm)	Horiz Scale (kHz cm)	Vert Scale (db cm)

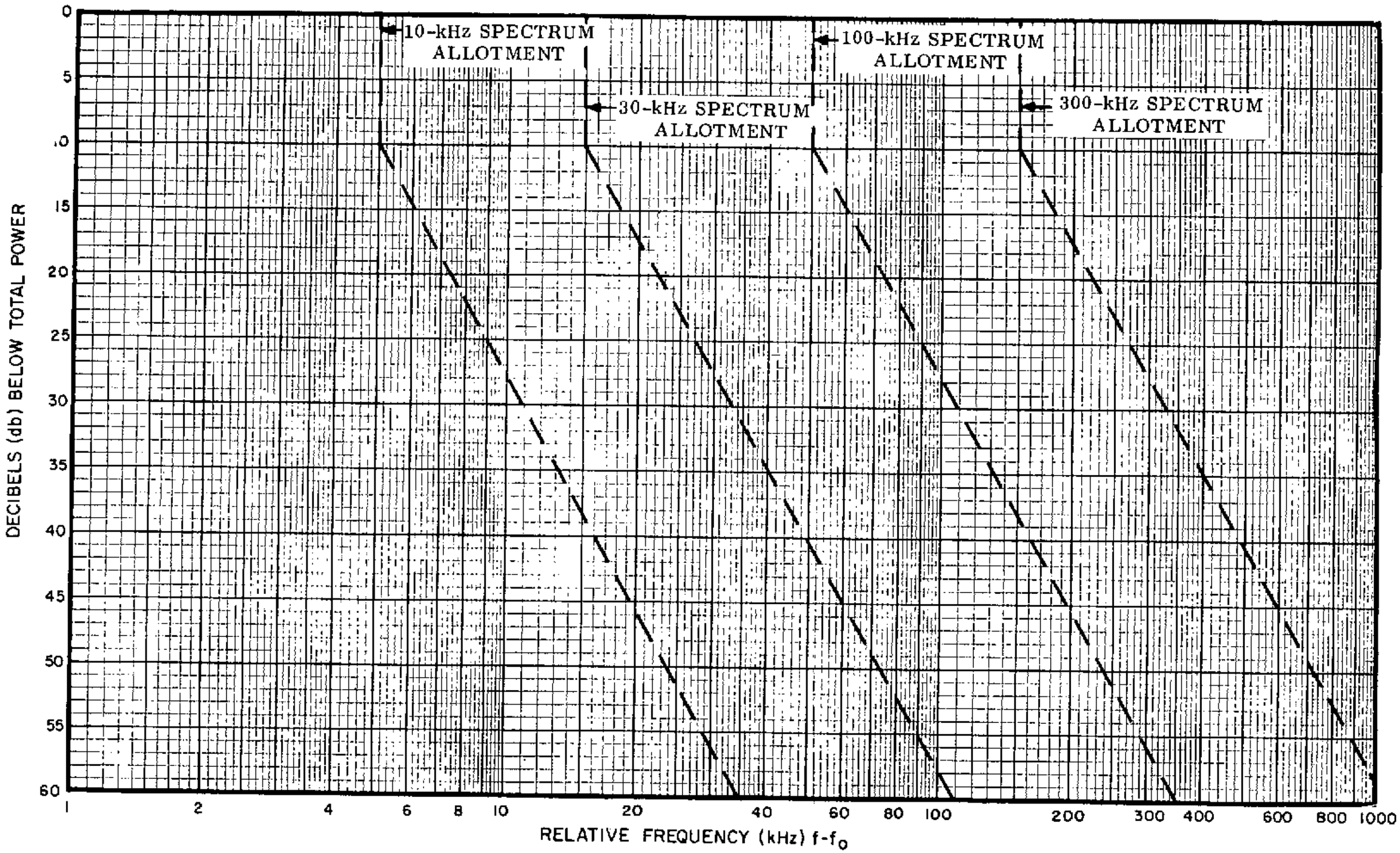
TEST DATA (Cont)

b. Test Results (interpreted)

The photographed data should be plotted on the attached spectrum width graph to determine if the spacecraft signal lies within the allotted bandwidth specified by the GSFC Aerospace Data Systems Standards. Any spurious signals which are discrete in frequency should be noted in the table below.

Spacecraft Mode	Spurious Emissions	
	DB Below Total Power	Frequency (MHz)

c. Remarks


10-kHz SPECTRUM ALLOTMENT
30-kHz SPECTRUM ALLOTMENT
100-kHz SPECTRUM ALLOTMENT
300-kHz SPECTRUM ALLOTMENT
DECIBELS (db) BELOW TOTAL POWER
0
5
10
15
20
25
30
35
40
45
50
55
60
1
2
4
6
8
10
20
40
60
80
100
200
300
400
600
800
1000
RELATIVE FREQUENCY (kHz) $f-f_0$

TEST DESCRIPTION

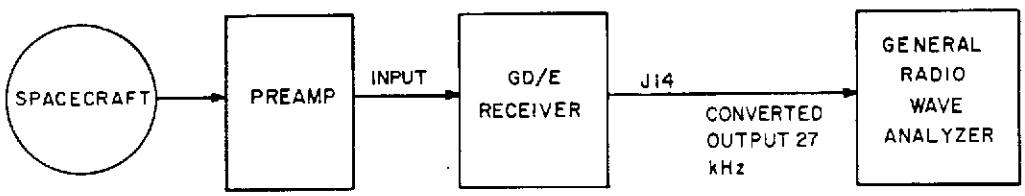
a. Purpose

A spectrum analysis is required to study the energy distribution of a spacecraft signal across the assigned frequency band. The spectrum (desired and spurious) is used to optimize receiving equipment parameters at STADAN stations. This information is also important in frequency conflict studies.

b. Equipment Configuration

This test procedure is for use with the General Radio Wave Analyzer, type 1900 A, and Graphic Level Recorder, type 1521 B. This equipment provides a calibrated, quick-look paper chart of the signal spectrum.

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

A minimum data spectrum width of three times the highest expected modulating frequency is examined under medium-signal-level conditions.

1. Set the type 1521-PIO-B drive unit to IDLE.
2. Set up the type 1900 A wave analyzer as required.
3. Set up the type 1521 B graphic level recorder as required.

4. Apply power to the wave analyzer and graphic level recorder and allow a 15 minute warm-up.

5. Calibrate the wave analyzer as required.

6. Connect the wave analyzer 100-kHz output to the graphic level recorder input. Connect GD/E receiver converted output to the wave analyzer input, and to a counter. Set GD/E receiver OCO FREQ switch to VAR 1. Adjust R115 (OCO FREQ) in the GD/E receiver drawer for a converted output frequency of 27 kHz $\pm$ 5 kHz.

7. Apply spacecraft signal to preamplifier at -60 dbm.

8. Adjust the frequency dial on the wave analyzer for the correct converted output frequency.

9. Adjust FULL SCALE and GAIN controls for full scale reading on the voltmeter.

10. Adjust the INPUT ATTENUATOR on the graphic level recorder to give approximately 70 db deflection of the POTENTIOMETER. Use GAIN control for fine adjustment to 70 db.

11. Record the horizontal and vertical calibrations of the graphic level recorder on the data sheet provided with Test 230. Record under Remarks any variations from test equipment parameters specified in this procedure.

12. Reduce frequency dial to 100 Hz lower than the converted output frequency. Set the DRIVE UNIT clutch to NON-SLIP, and lower the pen.

13. Start recorder by placing CHART DRIVE switch to FWD.

14. Allow the drive to run until the frequency dial on the wave analyzer reads at least the converted output frequency, plus three-times the highest expected modulating frequency.

15. Properly annotate the graphic recording and attach it to the data sheet of Test 230.

TEST DESCRIPTION

a. Purpose

The spectrum analysis is required to study the energy distribution of the received spacecraft signal across the assigned frequency band. The spectrum study shows desired and spurious signal distribution and is used to optimize receiving equipment parameters at STADAN stations. This information is also important in evaluating potential RF interference when operating in orbit with other spacecraft.

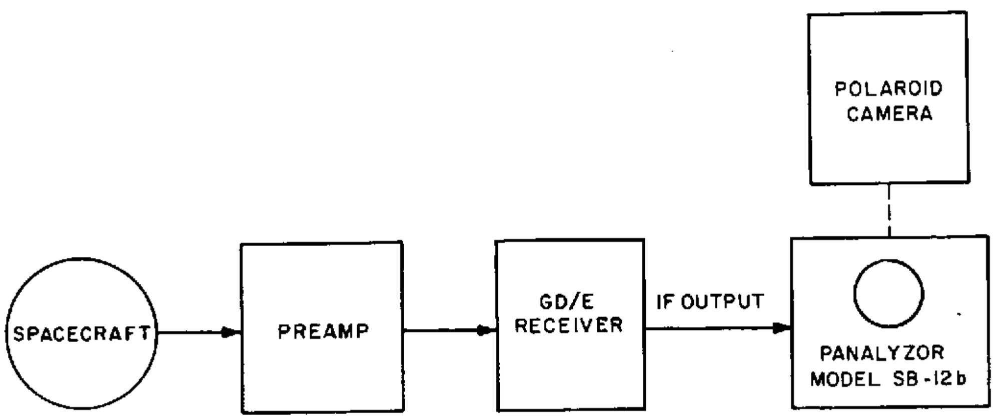
b. Equipment Configuration

This test procedure utilizes the Panoramic Electronics Model SB-12b Panalyzor. The received spectrum is displayed on a CRT, and Polaroid pictures are taken to provide a permanent spectrum record.

Major equipment parameters and connections are shown in the Compatibility Test Equipment Configuration Block Diagram, with the following additions:

1. Set the GD/E receiver IF bandwidth to 300 kHz.

2. Connect the spectrum analyzer as shown below:



c. Procedure

A minimum data spectrum width of three times the highest expected modulating frequency will be examined under medium-signal-level conditions. Polaroid photographs will be taken of each observed spectrum.

1. Turn on power to the panalyzor and allow a 30-minute warm-up.
2. Set the panalyzor controls as required and record the control settings on the data sheet.
3. Connect the IF output of the GD/E receiver to the input of the panalyzor.
4. Set the spacecraft signal input to the preamp to -60 dbm.
5. Adjust the MAIN TUNING control to center the data spectrum on the CRT.
6. Adjust the GAIN control as required to obtain a full-scale display on the panalyzor CRT. The INPUT ATTENUATOR may be used to reduce the signal level.
7. Take a photograph of the CRT display. Annotate the back of each spectrum photo with a number, the spacecraft mode of operation, receiver IF bandwidth and the horizontal and vertical calibration of the panalyzor.
8. Take spectrum photographs of a representative sampling of all spacecraft modes of operation.
9. Fill out the data sheet of Test 230 and record any deviations from this procedure under the Remarks section.

TEST DESCRIPTION

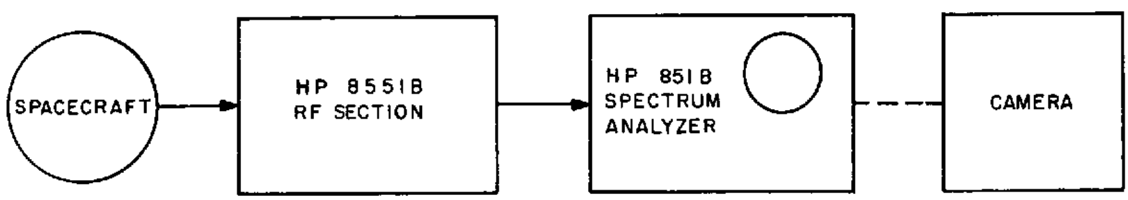
a. Purpose

This spectrum analysis is required to study the energy distribution of the received spacecraft signal. The second- and third-carrier harmonic frequencies and the baseband spectrum will be examined, and the spectral distribution will be studied. The spectrum study will show desired and spurious signal distribution and will be used to optimize receiving equipment parameters at STADAN stations. This information is also important in evaluating potential RF interference with other spacecraft during orbit operations.

b. Equipment Configuration

This test procedure makes use of the Hewlett-Packard HP 851B Spectrum Analyzer and HP 8551B RF Receiver Section. This equipment provides a visual display on a CRT. These displays will be photographed for permanent spectrum records.

The cable length from spacecraft to spectrum analyzer should be minimized. Equipment parameters and connections are shown in the Compatibility Test Equipment Configuration Block Diagram, with the following additions.



c. Procedure

1. Turn on power and allow all equipment to warm up for 30 minutes.

2. Set the HP 851B spectrum analyzer controls as required and record the settings on the data sheet of Test 230.

3. Ascertain that the ATTENUATOR DETENT is engaged. Apply the spacecraft signal to the input of the spectrum analyzer. Set the signal level to minimize second harmonic distortion by the spectrum analyzer.

4. Use the IF GAIN control and/or INPUT ATTENUATOR to obtain a full-scale display of the signal on the spectrum analyzer CRT.

5. Take a photograph of the CRT display. Annotate the back of each spectrum photo with a number, the spacecraft mode of operation, the sweep rate, and the horizontal and vertical scale factors of the spectrum analyzer.

6. Take spectrum photographs of a representative sampling of all spacecraft modes of operation.

7. Any deviations from this procedure should be recorded under Remarks on the data sheet of Test 230.

FREQUENCY MODULATION DEVIATION

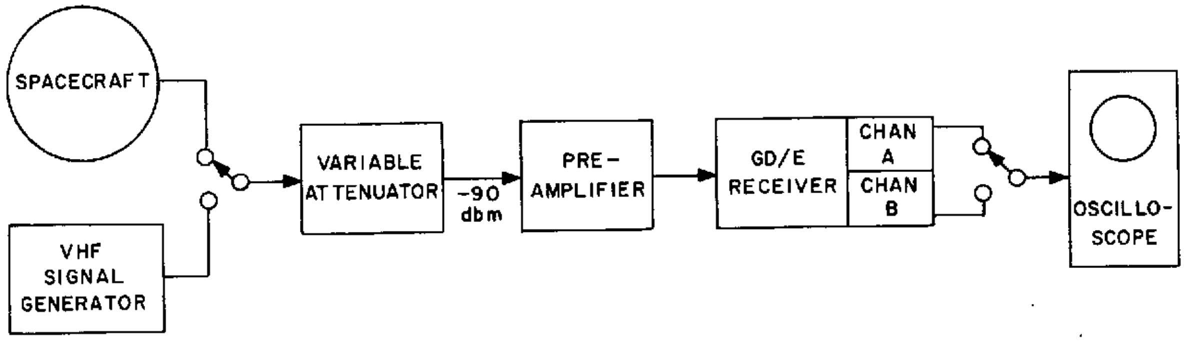
TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine the frequency modulation deviation of the spacecraft telemetry in order to ensure that the selected STADAN receiver parameters are optimum for data acquisition.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, except that the channel A or channel B output of the GD/E receiver is connected to the vertical input of a calibrated oscilloscope.



c. Procedure

1. Apply the spacecraft signal to the preamplifier at -90 dbm.

2. Adjust the oscilloscope VERTICAL GAIN and SWEEP SPEED for a display of the data waveform. Use dc coupling at the oscilloscope input.

NOTE

A dc level of several volts will be present on the data, and the waveform should be positioned vertically to eliminate this dc offset. The use of a Tektronix Type W plug-in is recommended, as it has built in facilities for zero offset. The oscilloscope vertical gain must be calibrated.

TEST DESCRIPTION (Cont)

3. Take a photograph of the oscilloscope display. The oscilloscope should be set for a single sweep and the graticule should be illuminated.

4. Repeat steps 1 through 3 for each data mode available from the transmitter under test.

5. Remove the spacecraft signal and apply a CW signal to the preamp input at -90 dbm. The frequency of the signal should be equal to the spacecraft nominal center frequency.

6. Make a multiple exposure calibration photograph as follows:

   a. Photograph the oscilloscope trace and graticule using continuous sweeps.

   b. Extinguish the graticule illumination.

   c. Tune the GD/E receiver above and below the nominal frequency of the spacecraft in equal increments to provide a total of five calibration points.

   d. At each point photograph the trace using continuous sweeps.

   e. The resulting calibration photograph should contain a properly exposed graticule, and five traces spaced to cover the graticule.

7. Annotate both photographs as required. In particular, the calibration photograph should be annotated with the frequencies to which the receiver was tuned. The data photograph should be referenced to the cal photo; e.g., "Cal photo No. 1 applies."

8. Determine the peak positive and peak negative deviation of the spacecraft transmitter by comparing the data photograph to the calibration photograph.

9. Complete a separate data sheet for each telemetry transmitter.

TEST DATA

Date: ________________ Spacecraft: ________________

Test Conductor: ________________ Model: ________________

Test Facility: ________________ Spacecraft Location: ________________

SOD-NAS Rep: ________________ Spacecraft Mode: ________________

a. Test Results

Applicable data photographs

Photo No.	Spacecraft Mode	Peak Deviation	
		Positive (kHz)	Negative (kHz)

Calibration Photograph No. ________________

Calibration Photograph Parameters

Receiver tuned to	MHz
Receiver tuned to	MHz
Receiver tuned to	MHz
Receiver tuned to	MHz
Receiver tuned to	MHz

b. Remarks

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AMPLITUDE MODULATION FACTOR

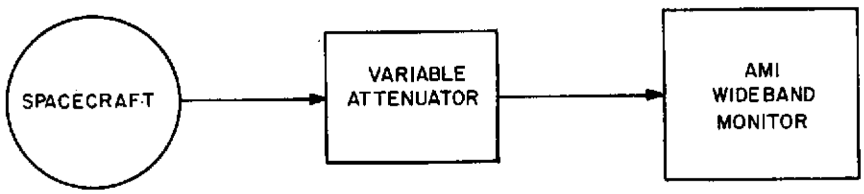
TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine the modulation factor of an amplitude-modulated spacecraft transmitter in order to ensure the selected STADAN receiver parameters are optimum for data acquisition.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

1. Apply the spacecraft signal to the Wide Band Monitor at -60 dbm.
2. Adjust the TUNING control for maximum indication on the level meter.
3. Adjust the SET LEVEL control so that level meter indication is on the red line.
4. Set the function selector to METER and SCOPE.
5. Set the DISPLAY control to AM.
6. Adjust the VERTICAL GAIN control for maximum vertical display on the scope.
7. Note and record the maximum and minimum levels of the trapezoid display.

TEST DESCRIPTION (Cont)

8. Calculate the modulation factor using the following formula:

$$M = \frac{E_{max} - E_{min}}{E_{max} + E_{min}}$$

9. Complete the data sheet.

TEST DATA

Date:	____________	Spacecraft:	____________
Test Conductor:	____________	Model:	____________
Test Facility:	____________	Spacecraft Location:	____________
SOD-NAS Rep:	____________	Spacecraft Mode:	____________

a. Test Results

1. Signal level ________ dbm
2. E_{max} ________ Div.
   E_{min} ________ Div.
3. Modulation factor ________

b. Remarks

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TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine the modulation factor of a phase-modulated spacecraft transmitter in order to ensure the selected STADAN receiver parameters are optimum for data acquisition.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

1. Set attenuation for -90 dbm spacecraft signal power at the input of the telemetry system preamplifier.

NOTE

The spacecraft spectrum width may exceed the IF bandwidth of the receiver. If this occurs, the data produced by this test may be erroneous. If the spectrum width is too wide, the IF bandwidth of the receiver should be increased.

2. Using a digital voltmeter, measure and record the AGC voltage of the telemetry receiver.

3. Using a digital voltmeter, measure and record the AGC voltage of the demodulator when properly locked to the modulated spacecraft signal.

4. Disconnect the spacecraft from the preamplifier and insert a calibration generator set to CW. Adjust output level of the calibration signal until the receiver AGC matches the value recorded in step 2. Record the generator attenuator setting.

TEST DESCRIPTION (Cont)

5. Lock the demodulator to the calibration signal. Record the demodulator AGC voltage.

6. Set the receiver gain control mode switch to the manual position and adjust the manual gain control until the demodulator AGC voltage matches the value recorded in step 5.

7. Monitor the demodulator AGC voltage. Slowly attenuate the calibration signal to match the demodulator AGC voltage recorded in step 3. Record the generator attenuator setting.

8. Subtract the attenuator setting of step 7 from step 4, and record.

9. Describe the type of modulation (sine wave, square wave, composite wave, etc.)

10. The accompanying graphs in this test are provided for computing the phase deviation versus the carrier drop.

PHASE MODULATION FACTOR

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Test Results

1. Receiver IF bandwidth ____________ kHz

2. Spacecraft signal applied

   (a) Receiver AGC ____________ VDC

   (b) Demodulator AGC ____________ VDC

3. Calibration generator applied

   (a) Attenuator setting (Receiver AGC mode) ____________ db

   (b) Demodulator AGC ____________ VDC

   (c) Attenuator setting (Receiver Manual Mode) ____________ db

4. Carrier drop (3a minus 3c) ____________ db

5. Type of modulation ____________

6. Phase deviation ____________ rms/peak

b. Remarks

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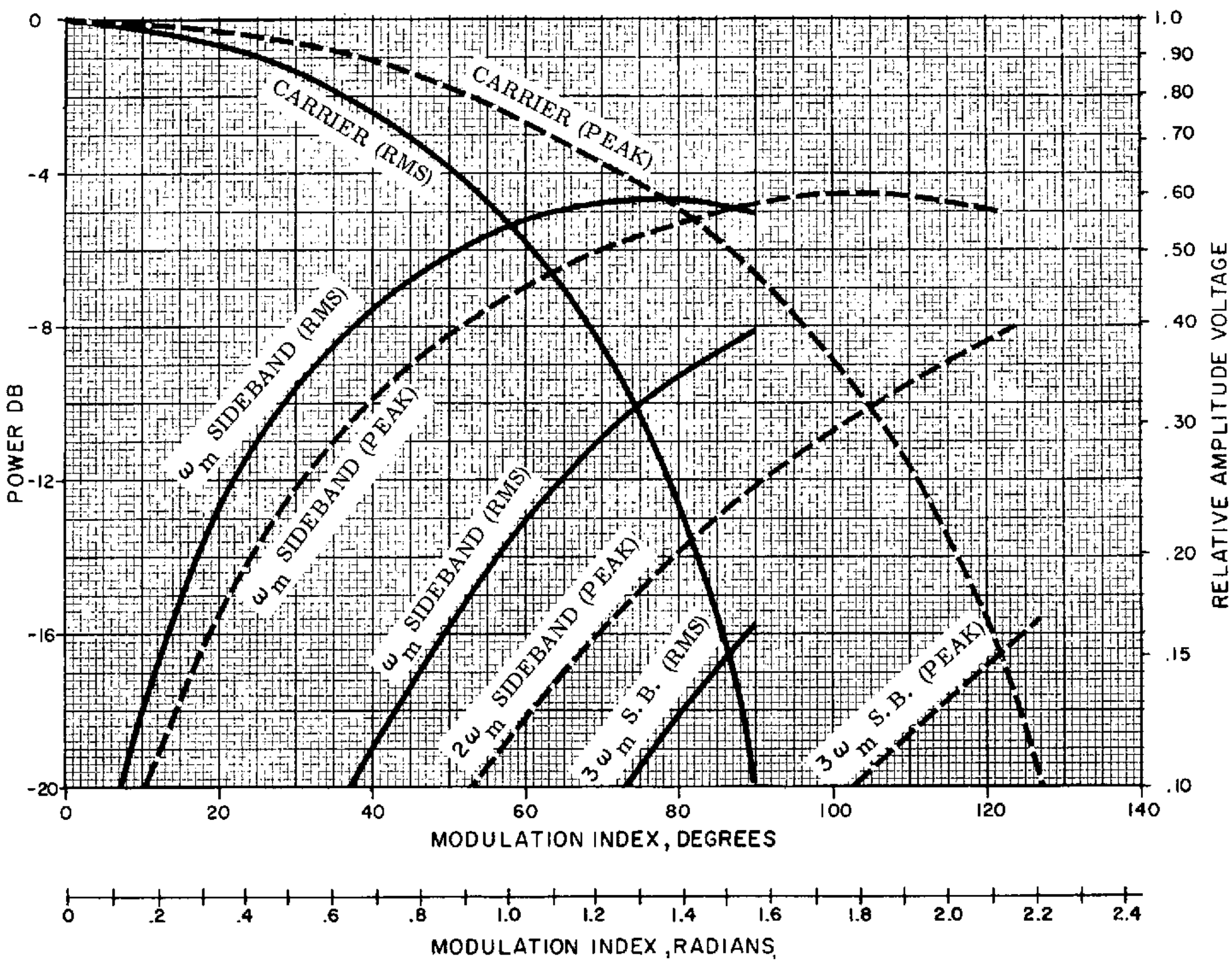
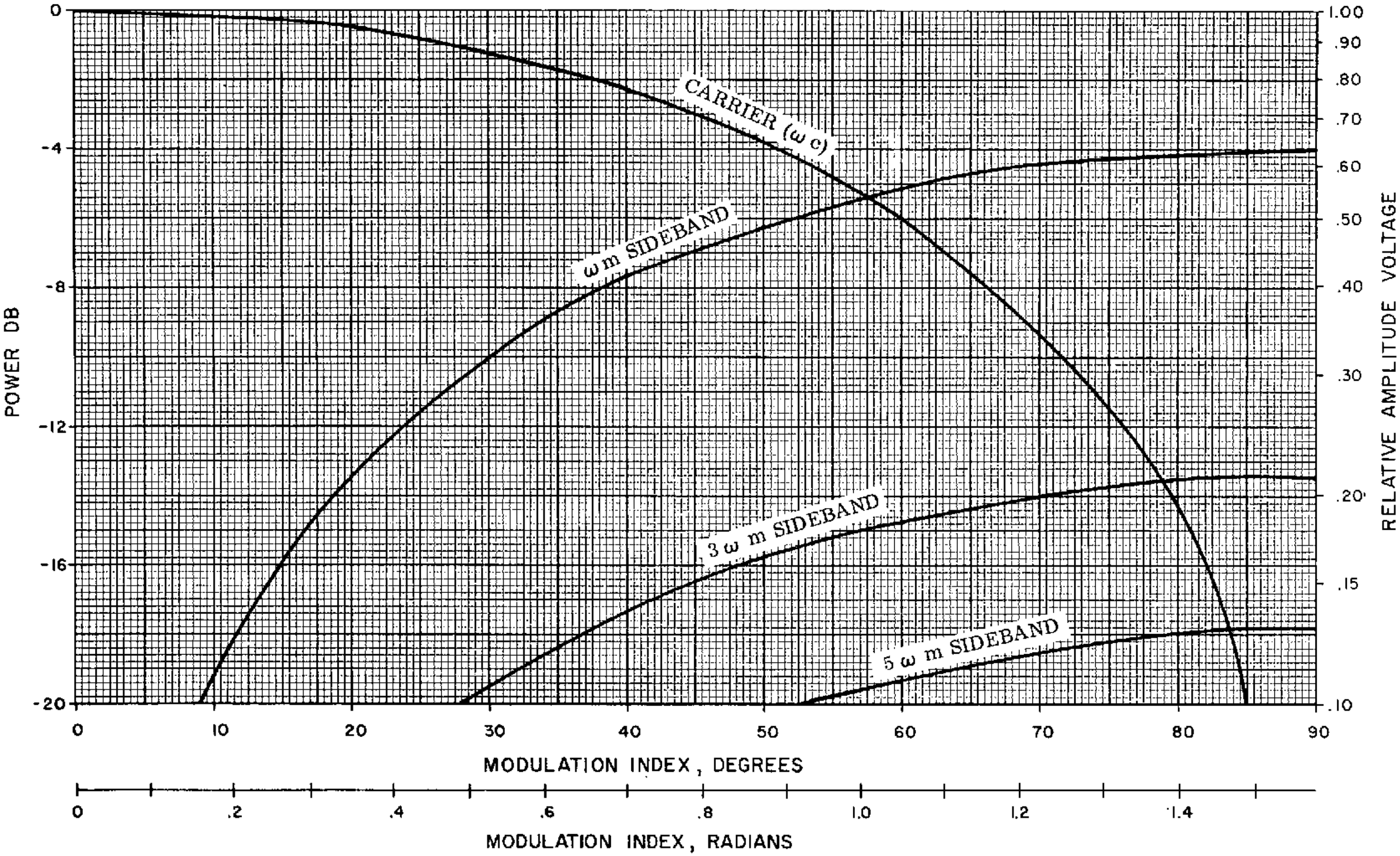
CARRIER DROP VS. MODULATION INDEX FOR SINE WAVE OR COMPOSITE WAVE



PHASE MODULATION FACTOR

TEST DATA (Cont)

CARRIER DROP VS. MODULATION INDEX
FOR SQUARE WAVE



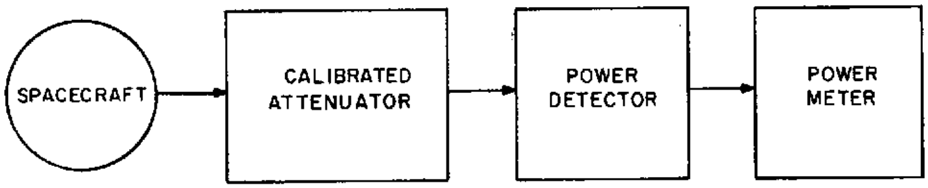
TEST DESCRIPTION

a. Purpose

The purpose of this test is to measure the power output of each spacecraft transmitter.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

1. Connect the calibrated attenuator to the transmitter output or the associated antenna terminal.
2. Record the power reading at the output of the calibrated attenuator, making sure that all spacecraft output terminals are properly terminated.
3. Record the attenuation between the power meter and the spacecraft.
4. Calculate and record the power output of the spacecraft.
5. Repeat steps 2, 3, and 4 for all output terminals of each transmitter aboard the spacecraft.
6. Complete one data sheet for each telemetry transmitter. On the blank data sheet, draw a block diagram for each spacecraft transmitter showing the circuitry within the spacecraft between the transmitter and point of connection of the power detector.

Date: ________________ Spacecraft: ________________

Test Conductor: ________________ Model: ________________

Test Facility: ________________ Spacecraft Location: ________________

SOD-NAS Rep: ________________ Spacecraft Mode: ________________

a. Test Results

1. Power detector used ______________

2. Power meter used ______________

3. Power measurement:

Meter Reading (mw)	Attenuation (db)	Power Output (watts)
	Total power output	

b. Remarks

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TEST DATA (Cont)

c. Block Diagram

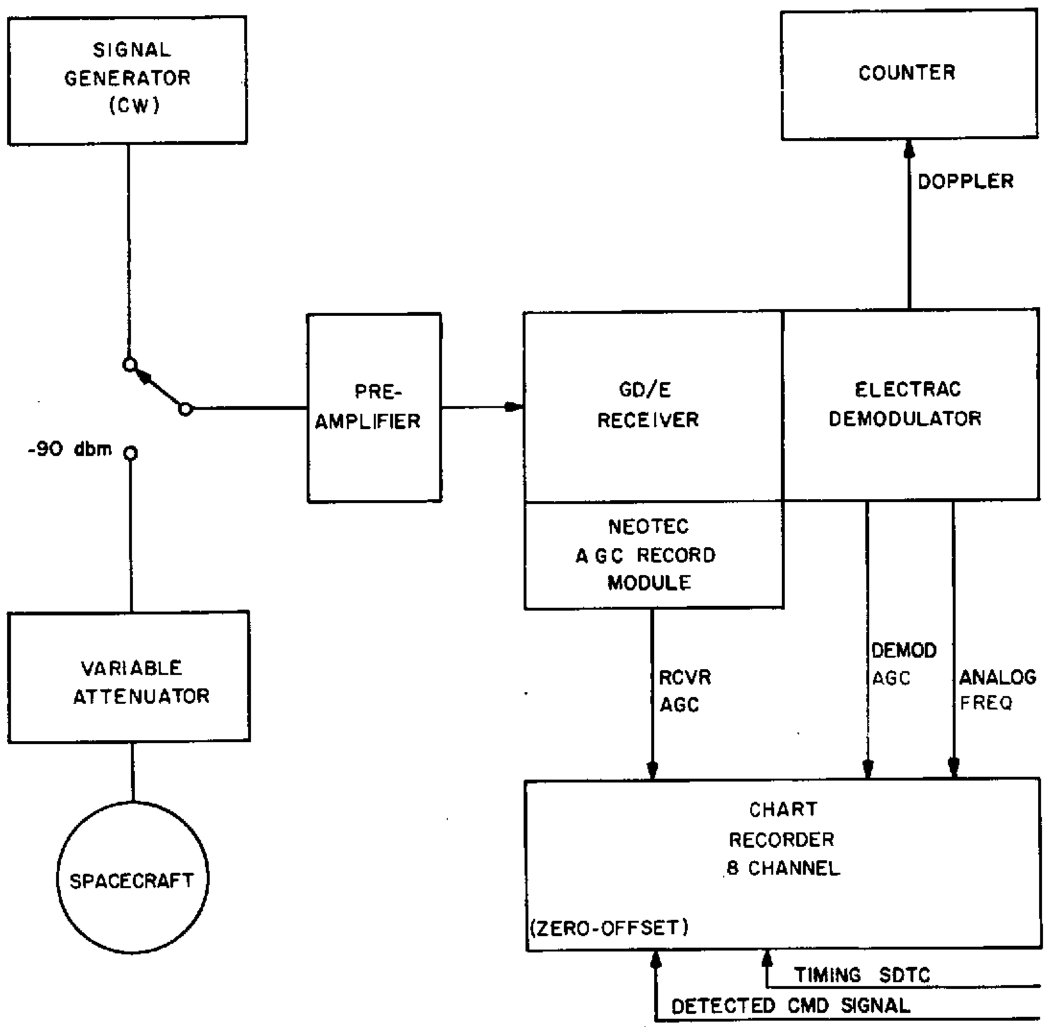
TEST DESCRIPTION

a. Purpose

This test will determine if the telemetry transmitter aboard the spacecraft generates frequency, power, or modulation transients which may cause the STADAN receivers to lose phase lock.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



TEST DESCRIPTION (Cont)

c. Procedure

During this test, the spacecraft telemetry signal will be supplied to the preamplifier at a signal level of -90 dbm. The AGC levels and the carrier center frequency will be monitored to ascertain if any transients exist which may cause the demodulator to lose lock during a particular spacecraft mode of operation or when switching spacecraft modes of operation.

1. Set up the equipment as indicated under equipment configuration.
2. Set the signal generator to the spacecraft frequency in a CW mode and adjust the attenuator for -90 dbm input to the preamplifier.
3. Lock the demodulator to the calibrate signal and set the loop bandwidth to 300 Hz.
4. Alternately increase and return to the receive frequency by a 1-kHz step. Calibrate the analog channel of the chart recorder for 1-kHz full-scale deflection. Center the trace with the ZERO SUPPRESSION control as required. (A 1-kHz increase in receiver frequency setting corresponds to a 1-kHz decrease in demodulator frequency setting or doppler frequency for the same input signal.)
5. Calibrate the receiver AGC on the chart recorder for 10 db full-scale deflection (-90 dbm to -100 dbm in 1 db steps).
6. Note the receiver AGC level on the chart recorder at -90 dbm input to preamplifier. Switch the receiver GAIN CONTROL MODE switch to MAN and readjust the gain to -90 dbm.
7. Calibrate the demodulator AGC on the chart recorder for 10 db full-scale deflection (-90 dbm to -100 dbm in 1 db steps). Place the receiver GAIN CONTROL MODE switch to AGC and set the demodulator loop bandwidth for the spacecraft parameters.

TEST DESCRIPTION (Cont)

8. Remove the calibration signal and insert the spacecraft signal. Adjust the variable attenuator to match the receiver AGC level on the chart recorder.

9. Adjust only the ZERO SUPPRESSION control on each recorder channel to center the stylus.

10. Issue a command for the spacecraft to switch to a different mode.

11. After each command, the demodulator should be checked to ensure that it has not locked on a sideband.

12. Observe the AGC level and the maximum frequency deviation on the chart recorder during and after spacecraft response.

13. Remove the spacecraft signal and insert the calibration signal at -90 dbm into the preamplifier. Postcalibrate the analog and AGC levels following steps 2 through 7.

14. Record any level or frequency change on the data sheet. Retain a copy of the chart recorder records until 30 days after launch.

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Test Results

CMD	Mode		Chart Recorder Deflection			Loss of Lock
	Old	New	Analog (Hz)	Rcvr AGC (db)	Demod AGC (db)	

b. Remarks

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TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine the threshold sensitivity of the phase-lock demodulator to a signal input from the spacecraft under test.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

1. Calculate the predicted phase-lock sensitivity.

NOTE

The predicted threshold usually occurs at a SNR of K_{db} in a bandwidth equal to twice the demodulator bandwidth. This corresponds to a signal which can be calculated by the following formula:

$$\text{Predicted Threshold} = -174 \text{ dbm/Hz} + K_{db} + NF_{db} + 10 \log 2B_{Hz} + C_{db}$$

where NF = Preamp noise figure
B = Loop bandwidth
K = +2 db for Electrac 215
K = +3 db for Electrac 315 (single channel)
C = Carrier drop measured in Test 245

The predicted acquisition level will vary according to the modulator characteristics of the spacecraft.

2. Set the preamplifier signal input power to -90 dbm.
3. Lock the phase-lock demodulator to the input signal.
4. Set the Loop Monitor Bandwidth to 1 Hz.

TEST DESCRIPTION (Cont)

5. Increase the attenuation until the demodulator loses lock. For purposes of this test, loss of lock is defined as the point where the dot on the monitor scope crosses the vertical axis more than once per second. Determine loss of lock three times and record the signal levels.

6. Decrease the attenuation and attempt reacquisition until the demodulator relocks and remains locked 100% of the time. Perform acquisition three times and record the signal levels. For purposes of this test, acquisition is defined as the point where the reference dot remains to the right of the vertical axis.

7. Complete the data sheet.

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Test Results

1. Demodulator model No. ______________
2. Demodulator serial No. ______________
3. System noise figure ______________ db
4. Demodulator loop bandwidth ______________ Hz
5. Predicted threshold ______________ dbm

	Loss of Lock (dbm)	Acquisition (dbm)
Trial 1		
Trial 2		
Trial 3		
Average		

b. Remarks

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SUBCARRIER DISCRIMINATOR THRESHOLD

TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine the threshold sensitivity of the subcarrier discriminator when operating with the spacecraft signal.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

1. With a calibrated attenuator, set the preamplifier input power to -90 dbm. If phase-locked demodulators are used, lock them to the input signal.
2. Increase attenuation until the data output to the strip chart recorder becomes unusable (in the opinion of the test conductor), indicating that the subcarrier discriminator threshold has been reached. Where appropriate, monitor the phase-lock demodulators to verify that they remain in the locked condition.
3. Record the data on the data sheet. The strip chart recording should be retained until 30 days after spacecraft launch.

SUBCARRIER DISCRIMINATOR THRESHOLD

TEST DATA

Date: ____________ Spacecraft: ____________

Test Conductor: ____________ Model: ____________

Test Facility: ____________ Spacecraft Location: ____________

SOD-NAS Rep: ____________ Spacecraft Mode: ____________

a. Test Results

1. Subcarrier discriminator model No. ____________
2. Subcarrier discriminator serial No. ____________
3. System noise figure ____________ db
4. Threshold data:

IRIG Channel No.	Discriminator Loop BW (Hz)	Discriminator Lowpass Filter	Threshold (dbm)

b. Remarks

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a. Purpose

The purpose of this test is to determine the threshold sensitivity of the PCM data-handling equipment (DHE) to a signal input from the spacecraft under test.

In order to extract usable data from a spacecraft telemetry signal, the signal power level must be greater than the threshold of the signal conditioner of the PCM DHE. The threshold will vary from spacecraft to spacecraft, depending upon modulation characteristics (bit rate, format, modulation index, etc.), and should be measured.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram. If the DHE is not available at the test location, the spacecraft signal recorded on the variable-level magnetic tape recorder, Test 612, will be reproduced at a location where the DHE is available and the test will be performed with this same test procedure. In this case, signal level changes must be annotated on the voice track of the magnetic tape.

c. Procedure

The threshold of the PCM/DHE signal conditioner is defined as that signal level at which the DHE loses frame lock when the DHE is set up to allow zero frame synchronization errors. For this test, the spacecraft signal level is varied while the DHE synchronization status indicators are monitored.

1. Calculate the predicted signal conditioner threshold.

NOTE

For phase-modulated signals, the predicted threshold usually occurs at a SNR of K_{db} in a bandwidth equal to twice the bit rate. This corresponds to a signal which can be calculated by the following formula:

Threshold signal =

$$-174 \text{ dbm/Hz} - NF_{db} - 10 \log B_{Hz} - S_{db} - K_{db}$$

where NF = Preamp noise figure in db
B = Bandwidth of twice the bit rate
S = Sideband correction factor (Test 245)
K = −4 db

2. Adjust the spacecraft signal for an input level of -90 dbm to the preamplifier. If phase-lock demodulators are employed, lock them to the spacecraft signal.

3. Lock the signal conditioner and allow the DHE format synchronizers (frame, subframe, etc.) to achieve the lock condition.

4. Slowly attenuate the spacecraft signal to the point at which the DHE synchronization status indicators show a loss of frame lock for greater than 10% of the time. Perform this step three times, each time returning to the fully locked condition, for verification of results. Record results on the data sheet provided.

5. Attenuate the spacecraft signal to the point where the DHE has lost lock for 100% of the time. Slowly decrease the attenuation until the DHE achieves frame lock for greater than 90% of the time. Perform this step three times for verification of results. Record results on the data sheet provided.

6. Record the predicted threshold on the data sheet. If the predicted threshold is not within 3 db of the measured value, explain the deviation under Remarks.

TEST DATA

Date: ________________ Spacecraft: ________________

Test Conductor: ________________ Model: ________________

Test Facility: ________________ Spacecraft Location: ________________

SOD-NAS Rep: ________________ Spacecraft Mode: ________________

a. Test Results

1. PCM signal conditioner model No. ________
2. PCM signal conditioner serial No. ________
3. PCM code type ________________
4. Bit rate ________________ bps
5. System noise figure ________________ db
6. Predicted threshold ________________ dbm
7. Data:

	Frame Sync Loss of Lock (dbm)	Frame Sync Acquisition (dbm)
Trial 1		
Trial 2		
Trial 3		
Average		

b. Remarks

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TEST DESCRIPTION

a. Purpose

The purpose of this test is to verify that the spacecraft sync pulse amplitude is constant with time, and to determine the amplitude variation with signal strength.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

1. Perform this test while conducting the Variable-level Magnetic Tape Recording, Test 612.
2. Set the Sanborn recorder chart speed to 0.5 mm/sec and record the output of the PFM sync pulse filter for the duration of the entire variable-level magnetic tape test.
3. Appropriately annotate the strip chart for identification of each signal level recorded.
4. Attach the entire strip chart recording to the data sheet to facilitate extraction of representative samples of the data.

TEST DATA

Date: ____________ Spacecraft: ____________

Test Conductor: ____________ Model: ____________

Test Facility: ____________ Spacecraft Location: ____________

SOD-NAS Rep: ____________ Spacecraft Mode: ____________

a. Test Results

1. PFM Model No. ____________

2. PFM Serial No. ____________

3. Attach strip chart recording

b. Remarks

TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine that the STADAN command equipment and the spacecraft are compatible.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

1. Adjust the variable attenuator to apply an input signal to the spacecraft command receiver which is +3 db above the command receiver threshold measured in Test 422 (Command Receiver Sensitivity and Desensitization by Telemetry Transmitter).

2. Send all commands that the spacecraft is designed to accept and check the telemetry (or the spacecraft, if applicable) for verification. Record results.

3. If equipment is not available for verifying all commands sent, make a steady-level tape recording during this test. Procedure is outlined in Steady-level Magnetic Tape Recording, Test 611.

TEST DATA

Date: ____________ Spacecraft: ____________

Test Conductor: ____________ Model: ____________

Test Facility: ____________ Spacecraft Location: ____________

SOD-NAS Rep: ____________ Spacecraft Mode: ____________

a. Test Results

1. Command input power ________________ dbm

2. Data:

Commands Sent	Response		Commands Sent	Response	
	No	Yes		No	Yes

TEST DATA (Cont)

Commands Sent	Response		Commands Sent	Response	
	No	Yes		No	Yes

b. Remarks

ZERO DBM TEST

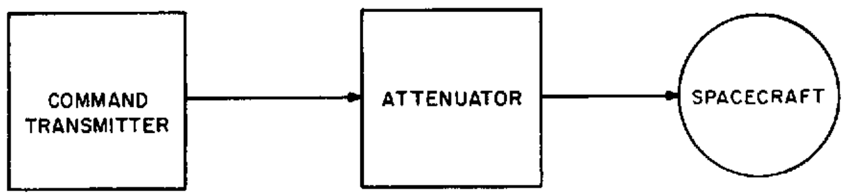
TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine whether the command receiver threshold will be degraded after exposure to high input levels.

b. Equipment Configuration

Equipment parameters and connections for threshold measurements are shown in the Compatibility Test Configuration Block Diagram. The following connections will be used for step 2 of this test :



c. Procedure

1. Establish the spacecraft command receiver threshold 3 times using the procedure of Test 422. Note the receiver thresholds on the data sheet and calculate the dbm average.

2. Set a 0-dbm signal source to the spacecraft receiver frequency and insert 0 dbm into the spacecraft receiver for 15 seconds.

3. Recheck the spacecraft receiver threshold 3 times using the procedure of Test 422. Note the receiver thresholds on the data sheet and calculate the dbm average.

4. Note any difference in the average threshold levels. Subtract the dbm average in step 3 from the dbm average in step 1 and record the difference on the data sheet.

TEST DATA

Test Date: ________________ Spacecraft: ________________

Test Conductor: ________________ Model: ________________

Test Facility: ________________ Spacecraft Location: ________________

SOD-NAS Rep: ________________ Spacecraft Mode: ________________

a. Test Results

1. Threshold established _________dbm

   _________dbm

   _________dbm _________dbm average

2. 0-dbm carrier (15 sec) _________ sec

3. Re-establish threshold _________dbm

   _________dbm

   _________dbm . _________dbm average

4. Threshold change (difference between steps 1 and 3) _________dbm

b. Remarks

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COMMAND RECEIVER SENSITIVITY AND DESENSITIZATION BY TELEMETRY TRANSMITTERS

TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine the sensitivity of the spacecraft command system. In addition, any desensitization of the command system caused by operation of the telemetry transmitters will be measured.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

Determine the minimum signal to which the command system will respond with all transmitters de-energized, then, with all possible combinations of transmitters energized.

1. List all transmitters on the data sheet.
2. Verify that the modulation index of the command transmitter is 80% (± 5%) for AM or 1-radian peak for PM.
3. Command all spacecraft transmitters off.
4. Starting 4 db below the anticipated threshold, send the command which will energize the lowest frequency transmitter. If the spacecraft fails to respond, increase the command signal level by 1 db and send the command again. Continue sending the command and increasing the signal level until the spacecraft responds three times in three trials at the same level. Record this level on the data sheet.

TEST DESCRIPTION (Cont)

5. Decrease the command signal level 2 db from the level found in step 4. Send the command which will energize the transmitter with the next highest frequency. If the spacecraft fails to respond, increase the command signal level by 1 db and send the command again. Continue sending the command and increasing the signal level until the spacecraft responds three times in three trials at the same level. Record the threshold level on the data sheet.

6. Repeat step 5 until all of the spacecraft transmitters have been energized. For each threshold measured, mark the transmitter ON/OFF combination on the data sheet.

7. Decrease the command signal level 2 db from the level found in step 4. Send the command which will de-energize the transmitter with the lowest frequency. If the spacecraft fails to respond, increase the command signal level by 1 db and send the command again. Continue sending the command and increasing the signal level until the spacecraft responds. Record each threshold level on the data sheet.

8. Repeat step 7 until all of the spacecraft transmitters have been de-energized. For each threshold measured, mark the transmitter ON/OFF combination on the data sheet.

9. When a spacecraft has three or more transmitters capable of simultaneous operation, vary the commanding on and commanding off sequences with various combinations turned on and off. For each combination send a command, increasing the signal level until the spacecraft responds. Record each threshold level on the data sheet. For each threshold measured, mark the transmitter ON/OFF combination on the data sheet.

10. Record the expected command receiver threshold as determined by the link calculations in the Compatibility Test Plan. If the average measured threshold differs from the calculated threshold by more than 2 db, explain the discrepancy under Remarks on the data sheet.

TEST DATA

Date:	________	Spacecraft:	________
Test Conductor:	________	Model:	________
Test Facility:	________	Spacecraft Location:	________
SOD-NAS Rep:	________	Spacecraft Mode:	________

a. Test Results

1. Expected command receiver threshold______dbm (obtained from NAS Link Calculations)

2. Transmitter functional description:

   Tx 1________________________

   Tx 2________________________

   Tx 3________________________

   Tx 4________________________

   Tx 5________________________

   Tx 6________________________

   Tx 7________________________

   Tx 8________________________

TEST DATA (Cont)

Tx 1	Tx 2	Tx 3	Tx 4	Tx 5	Tx 6	Tx 7	Tx 8	Threshold (dbm)

Transmitter on: X Transmitter off: 0

b. Remarks

____

____

TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine the minimum level of modulation required to command the spacecraft.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

This procedure consists of commanding the spacecraft, starting at 5% modulation, and increasing the modulation to the point where the spacecraft command system responds.

1. Set the output of the command transmitter to a level 10 db above the threshold of the spacecraft command system. Record this level on the data sheet.
2. Select a command which can be easily verified.
3. Beginning with a low percentage of modulation, increase the modulation in small increments, commanding three times at each level. Continue increasing the modulation percentage until the spacecraft responds three out of three times.
4. Measure the threshold modulation percentage, using the AMI oscilloscope display and the relationship:

$$\%M = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} \times 100$$

Record the modulation threshold, as calculated above, on the data sheet.

TEST DATA

Test Date:	________	Spacecraft:	________
Test Conductor:	________	Model:	________
Test Facility:	________	Spacecraft Location:	________
SOD-NAS Rep:	________	Spacecraft Mode:	________

a. Test Results

1. Command input power ________ dbm
2. Command selected ________ Console code
3. Measured modulation sensitivity ________ %

b. Remarks

____
____
____
____
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____
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COMMAND RESPONSE TO CORRECT COMMANDS AT HIGH SIGNAL-TO-NOISE RATIOS

TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine that the STADAN command equipment and the spacecraft equipment are compatible at high signal-to-noise ratios.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

1. Adjust the variable attenuator to apply an input signal of approximately -30 dbm to the spacecraft command receiver.
2. Send approximately 6 commands that the spacecraft is designed to accept and check the telemetry (or the spacecraft, if applicable) for verification. Record the results.
3. If equipment is not available for verification of all commands sent, make a steady-level tape recording during the test. The recording procedure is outlined in Test 611 (Steady-level Magnetic Tape Recording).

COMMAND RESPONSE TO CORRECT COMMANDS
AT HIGH SIGNAL-TO-NOISE RATIOS
TEST DATA

Date: ____________ Spacecraft: ____________

Test Conductor: ____________ Model: ____________

Test Facility: ____________ Spacecraft Location: ____________

SOD-NAS Rep: ____________ Spacecraft Mode: ____________

a. Test Results

1. Command input power ____________ dbm

2. Data:

Commands Sent	Response		Commands Sent	Response	
	No	Yes		No	Yes

b. Remarks

____

____

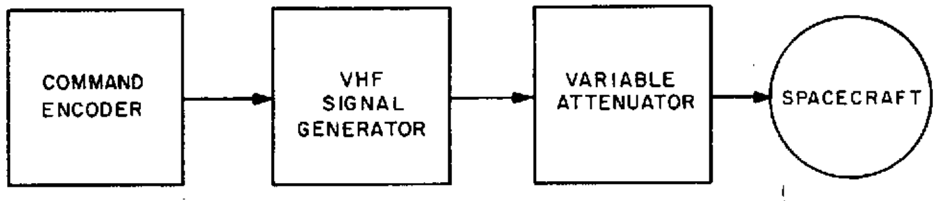
____

a. Purpose

The purpose of this test is to determine the bandpass response of the spacecraft command receiver.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

1. Tune the signal generator to the spacecraft command frequency and record the frequency on the attached data sheet.

2. Set up the command encoder for sending the selected commands at 80% AM (or 1-radian-peak PM, if applicable).

3. Starting below the measured threshold level (see Test 422) decrease the variable attenuator in 1-db steps and execute the selected command at each step. Record the attenuator setting at which the spacecraft responds.

4. Starting at the normal spacecraft command frequency (f_o), decrease the frequency setting of the signal generator in 10-kHz steps. Record the frequency (f) on the data sheet. Repeat step 3 at each new frequency and record the attenuator setting for each frequency. Continue until the signal level input to the spacecraft is 60 db above threshold.

5. Starting at the normal spacecraft command frequency (f_o), increase the frequency setting of the signal generator in 10-kHz steps. Record the frequency (f) on the data sheet. Repeat step 3 at each new frequency and record the attenuator setting for each frequency. Continue until the signal level input to the spacecraft is 60 db above threshold.

6. Plot the frequency ($f - f_o$) versus the attenuator setting (db) on the blank graph provided to obtain the command receiver bandpass response.

TEST DATA

Test Date: ________________ Spacecraft: ________________

Test Conductor: ________________ Model: ________________

Test Facility: ________________ Spacecraft Location: ________________

SOD-NAS Rep: ________________ Spacecraft Mode: ________________

a. Test Results

1. A spacecraft input power level of __________ dbm corresponds to an attenuator setting of __________ db.

2. Bandpass data:

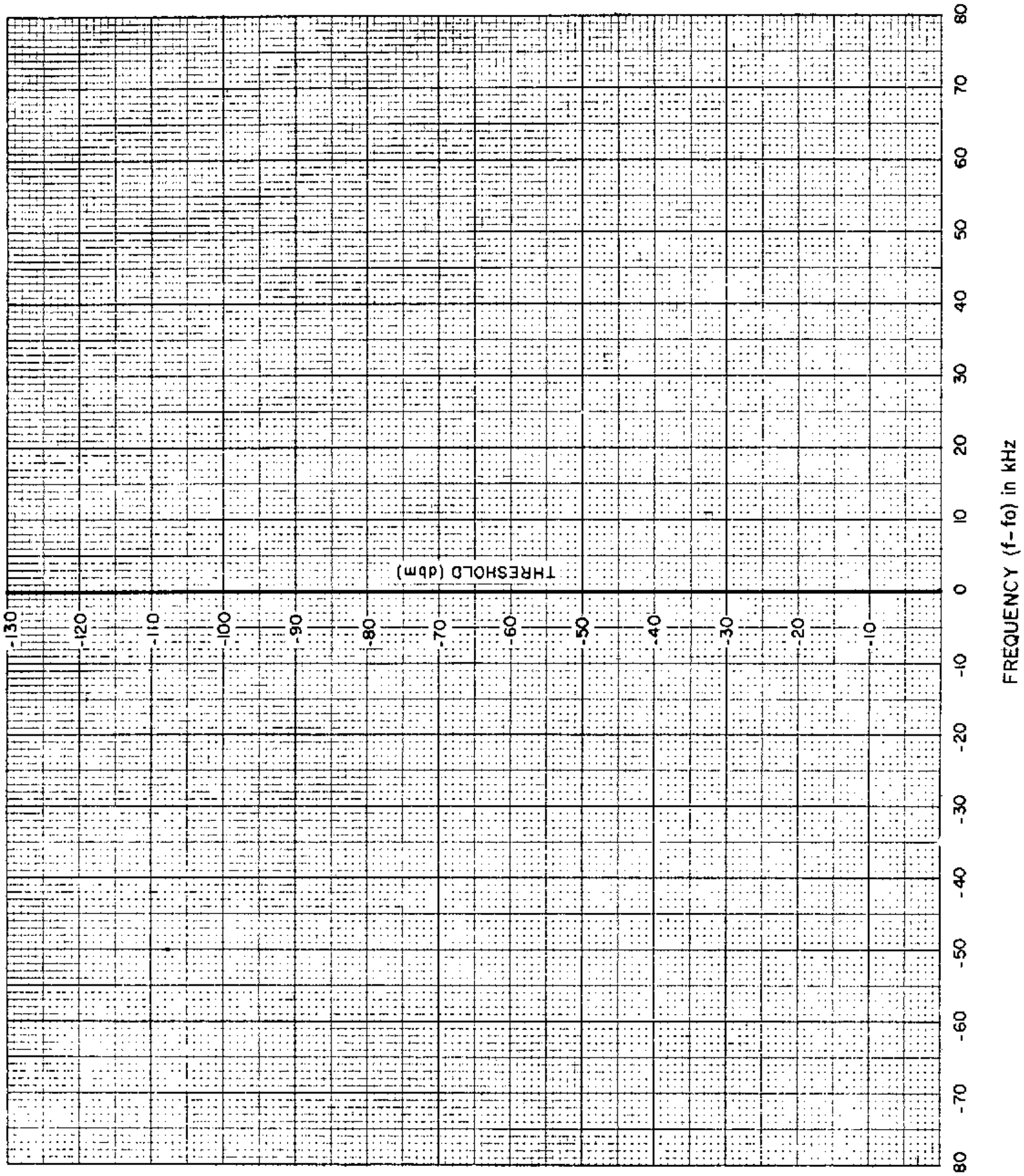
Frequency (MHz)	Attenuator Setting (db)	Power Input to S/C (dbm)

b. Remarks

____

____

TEST DATA (Cont)



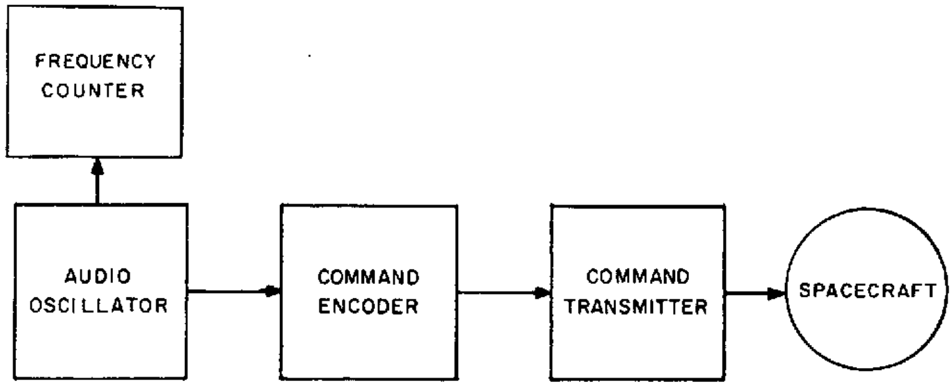
TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine the frequency range over which the spacecraft GRARR 4-kHz tone filter will respond.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

1. Adjust the variable attenuator for a command transmitter signal level of -90 dbm at the spacecraft input.
2. Verify the index of modulation (1-radian peak) at a convenient setting of the command encoder.
3. Adjust the audio oscillator for an output frequency of 4 kHz (holding tone). Adjust the audio oscillator output level to obtain 1-radian-peak phase modulation of the command transmitter.
4. With the spacecraft operating in the telemetry mode, transmit the GRARR ON command (1-second address tone, 0.5-second blank, and 4-kHz tone).

TEST DESCRIPTION (Cont)

5. Maintaining the holding tone, slowly decrease the output frequency of the audio oscillator and determine, to an accuracy of 1 Hz, the frequency at which the spacecraft drops out of the GRARR mode. Record this frequency on the data sheet provided.

6. Perform steps 3, 4, and 5 three times for verification of results.

7. Repeat step 6, increasing the audio oscillator frequency instead of decreasing it. Record the results on the data sheet provided.

TEST DATA

Date: ________________ Spacecraft: ________________

Test Conductor: ________________ Model: ________________

Test Facility: ________________ Spacecraft Location: ________________

SOD-NAS Rep: ________________ Spacecraft Mode: ________________

a. Test Results

	4-kHz Tone Frequency Lower Limit (Hz)	4-kHz Tone Frequency Upper Limit (Hz)
Trial 1		
Trial 2		
Trial 3		

b. Remarks

TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine how far in error a tone digital command subcarrier may be and still obtain a correct command response from the spacecraft command system. STADAN subcarrier frequencies are held to a $\pm$ 0.005% tolerance.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram. A variable frequency audio generator is used in the command encoder in place of the appropriate tone oscillator.

c. Procedure

The audio generator is set to the correct clock frequency (f_o); selected commands are sent to verify that the spacecraft will respond. The clock frequency is then increased above and below nominal to determine the maximum offset which the spacecraft will tolerate. Proceed through the following steps:

1. Set the output frequency of the audio generator to within 1.0 Hz of the command clock frequency of the spacecraft under test.
2. Set the audio generator level equal to the level which is normally supplied by the encoder clock oscillator.
3. Verify that the command transmitter is modulated 80 $\pm$ 5%.
4. Send selected commands and verify that the spacecraft responds properly.
5. Gradually increase the clock frequency until the spacecraft will no longer respond. Decrease the clock frequency slightly to determine the maximum usable frequency (f_{max}).
6. Repeat step five for frequencies below nominal to determine the minimum usable frequency (f_{min}).
7. Complete the data sheet.

Date:	______________	Spacecraft:	______________
Test Conductor:	______________	Model:	______________
Test Facility:	______________	Spacecraft Location:	______________
SOD-NAS Rep:	______________	Spacecraft Mode:	______________

a. Test Results

1. Nominal clock frequency (f_o) ______________ Hz
2. Maximum usable frequency (f_{max}) ______________ Hz
3. Minimum usable frequency (f_{min}) ______________ Hz
4. Required clock accuracy:

$$\frac{f_{max} - f_o}{f_o} \times 100 = \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_} \%$$

$$\frac{f_o - f_{min}}{f_o} \times 100 = \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_} \%$$

b. Remarks

____
____
____
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____

TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine how far in error an address command tone may be and still obtain a reliable response from the spacecraft command system. STADAN address frequencies are held to a ± 0.005% tolerance.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compaitibility Test Configuration Block Diagram. A variable frequency audio generator is used in the command encoder in place of the appropriate tone oscillator.

c. Procedure

The audio generator is set to the correct address frequency; (f_o); selected commands are sent to verify that the spacecraft will respond. The address frequency is then increased above and below nominal to determine the maximum offset which the spacecraft will tolerate. Proceed through the following steps.

1. Set the output frequency of the audio generator to within 1.0 Hz of the nominal address frequency.
2. Set the audio generator level equal to the level which is normally supplied by the tone oscillator.
3. Verify that the command transmitter is modulated 80 ± 5%.
4. Send selected commands and verify that the spacecraft responds properly.
5. Gradually increase the address frequency until the spacecraft will no longer respond. Decrease the address frequency slightly to determine the maximum usable frequency (f_{max}).
6. Repeat step five for frequencies below nominal to determine the minimum usable frequency (f_{min}).
7. Complete the data sheet.

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Test Results

1. Nominal address frequency (f_o) ______________ Hz
2. Maximum usable frequency (f_{max}) ______________ Hz
3. Minimum usable frequency (f_{min}) ______________ Hz
4. Required tone accuracy:

$$\frac{f_{max} - f_o}{f_o} \times 100 = \_\_\_\_\_\_\_\_ \%$$

$$\frac{f_o - f_{min}}{f_o} \times 100 = \_\_\_\_\_\_\_\_ \%$$

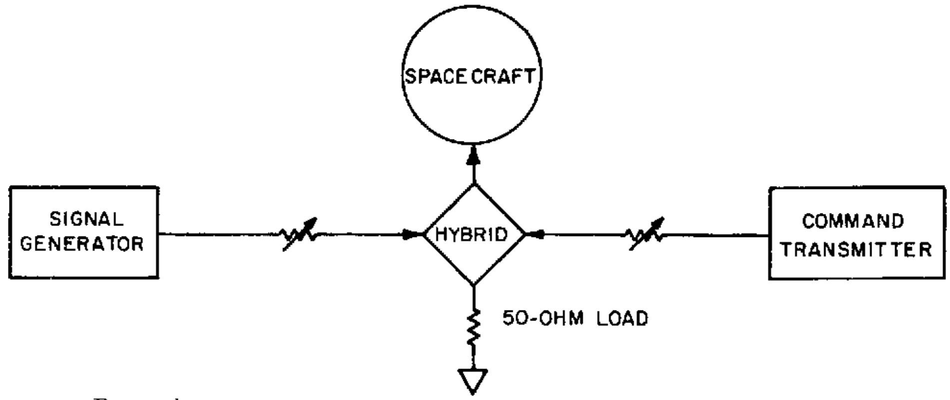
b. Remarks

a. Pupose

This test will determine the response of the spacecraft command receive system to spurious CW carriers in the vicinity of the command frequency.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

1. Tune the signal generator and the command transmitter to the spacecraft command frequency (f_0). Record the measured command transmitter frequency on the data sheet provided.

2. Adjust the command transmitter to obtain a signal level 15 db above the spacecraft command receiver threshold. Verify the percentage or index of modulation (80% AM, 1-radian-peak PM).

3. Adjust the signal generator for a CW carrier at the command frequency and at a signal level of 35 db above the spacecraft command receiver threshold.

4. Send a selected OFF command and reduce the level of the interfering CW signal (f_I) until the command is executed. Record, on the data sheet provided, the ratio of the desired signal in db to the interfering signal in db. Positive db means the desired signal is stronger in level than the interfering signal.

5. Perform steps 3 and 4 three times to verify the results.

TEST DESCRIPTION (Cont)

6. Repeat steps 3, 4, and 5 at frequencies offset by the address tone or clock frequencies, and at other frequencies in the bandpass to obtain a smooth plot of the desired signal to interfering signal ratio. As a rule consecutive measurements should not differ by more than 3 db.

7. Plot the results on the attached graph. Indicate command signal level (0 db line) and interfering signal rejection curve.

TEST DATA

Date: ____________ Spacecraft: ____________

Test Conductor: ____________ Model: ____________

Test Facility: ____________ Spacecraft Location: ____________

SOD-NAS Rep: ____________ Spacecraft Mode: ____________

a. Test Results

1. Command frequency (f_o) ____________ MHz

2. Command receiver power input (P_S) ____________ dbm

3. An interference power (P_I) level of ____________ dbm corresponds to an attenuator setting of ____________ db

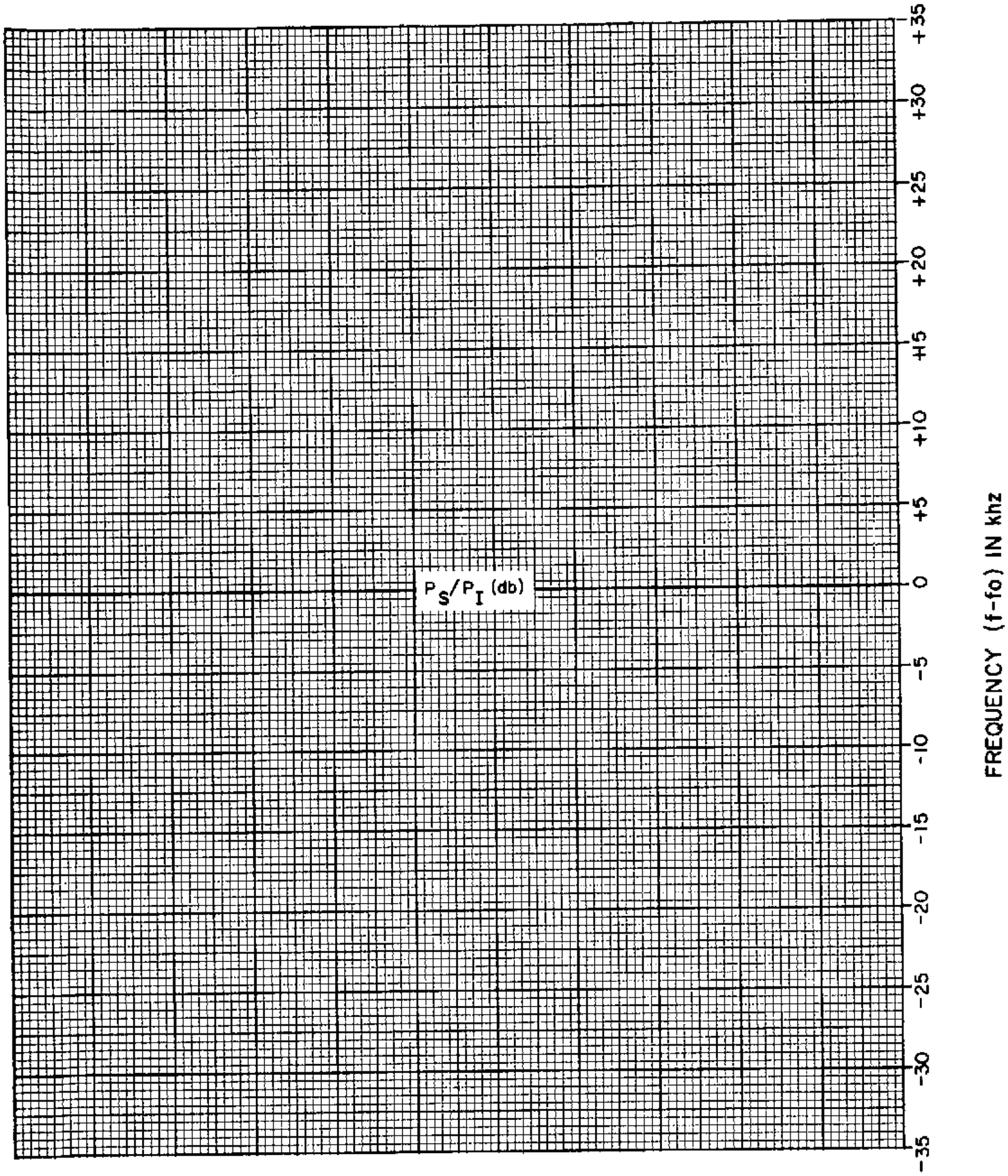
f_I (MHz)	Interference Attenuator Setting (db)	$f_I - f_o$ (kHz)	P_S/P_I (db)

TEST DATA (Cont)

f_I (MHz)	Interference Attenuator Setting (db)	$f_I - f_o$ (kHz)	P_s/P_I (db)

b. Remarks

TEST DATA (Cont)



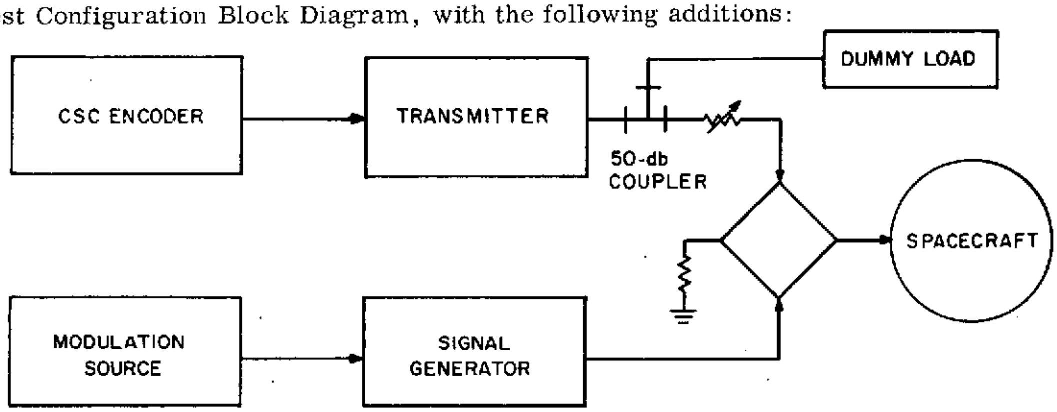
TEST DESCRIPTION

a. Purpose

Since the allotted spacecraft command frequency bands are not exclusively used for spacecraft command operations, there is a good possibility of interference from an undesired station during command operations. The purpose of this test is to determine the response of the spacecraft command system to commands in the presence of spurious AM signals.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

A modulation source (usually a receiver or tape recorder) is used to modulate a signal generator. This source simulates an interfering signal. The desired signal to interfering signal ratio is then determined.

1. Tune the command transmitter and the spurious signal transmitter to the spacecraft assigned frequency and record the measured frequency on the data sheet.

2. Adjust the output of the command encoder to modulate the transmitter to a level of 80% AM.

3. Adjust the output of the modulation source to a sufficient level to modulate the signal generator to 80% AM.

TEST DESCRIPTION (Cont)

4. Set the output of the transmitter to 10 db above the spacecraft command receiver threshold. Record this level on the data sheet.

5. While sending selected spacecraft commands with the command encoder and transmitter, increase the output power of the signal generator to the point where the spacecraft receiver does not respond. Record this level on the data sheet.

TEST DATA

Date: ____________ Spacecraft: ____________

Test Conductor: ____________ Model: ____________

Test Facility: ____________ Spacecraft Location: ____________

SOD-NAS Rep: ____________ Spacecraft Mode: ____________

a. Test Results

1. Transmitter

Frequency ____________MHz

Threshold level plus 10 db ____________db

2. Signal generator

Frequency ____________MHz

Desensitization level ____________db

b. Remarks

____

____

____

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____

TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine the response of the spacecraft command system to false commands consisting of an incorrect address and a correct execute.

b. Equipment Configuration

Equipment parameter and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

1. Tune the command transmitter to the frequency assigned to the spacecraft.
2. Adjust the output of the command encoder to modulate the transmitter to a level of 80% for AM (or 1-radian peak for PM, if applicable).
3. Adjust the variable attenuator to apply an input signal to the spacecraft command receiver which is +3 db above the command receiver threshold measured in Test 422 (Command Receiver Sensitivity and Desensitization by Telemetry Transmitter).
4. Select a command from the list of commands which the spacecraft is designed to accept and which can be verified by observation. Set up this command on the command encoder.
5. Observe the spacecraft or the telemetry output to ascertain if the system responds to false addresses while executing steps 6 or 7.
6. For tone command systems, execute each authorized address while sending the selected execute command each time.
7. For tone digital command systems, transmit the correct clock frequency with selected incorrect address codes and correct execute codes.

COMMAND RESPONSE TO FALSE ADDRESSES

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Test Results

1. Command input power ______________ dbm

2. Data:

Address	Execute	Response	
		Yes	No

b. Remarks

____

____

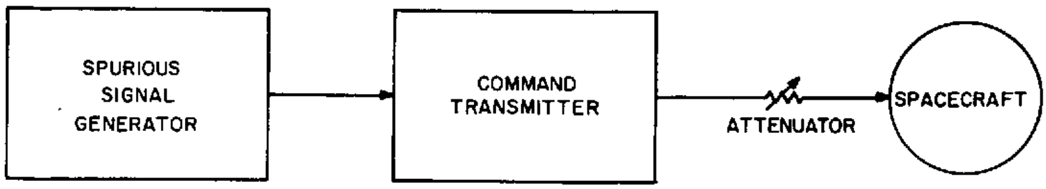
____

a. Purpose

The purpose of this test is to determine the response of the spacecraft command system to spurious signals.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

1. Feed the output of the spurious signal generator into the command transmitter. The type of the spurious signal generator will be decided by the Network Assurance Section.

2. Tune the spurious signal generator for a high-frequency cut-off of 20 kHz.

3. Increase the output level of the spurious signal generator to modulate the command transmitter to a level of 80% AM (or 1-radian-peak PM, if applicable).

4. Adjust the variable attenuator to apply a signal 20 db above the spacecraft command receiver threshold.

5. Observe the spacecraft for a command response for a period of 5 minutes.

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Test Results

1. Command Response Yes__________ No__________

2. Nature of spurious signals ______________________

b. Remarks

COMMAND RESPONSE OF PM RECEIVERS TO AM COMMANDS

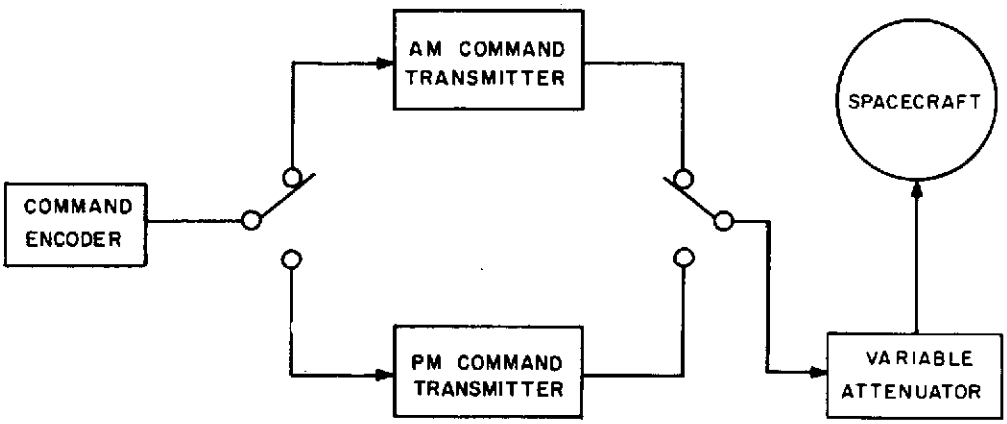
TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine whether a spacecraft designed to accept PM commands will respond to AM commands. The simulated spurious signals will employ carrier center frequencies and modulation not intended for this spacecraft and will employ the command format which the spacecraft is designed to accept.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

1. Tune both command transmitters to the spacecraft command frequency and record the measured frequencies on the data sheet provided.

2. Select the PM command transmitter.

3. Set the command encoder to transmit any command which the spacecraft is designed to accept. (Choose one that is easily verified.)

4. Transmit the command three times for verification of results and record any spacecraft response on the data sheet provided.

TEST DESCRIPTION (Cont)

5. Switch to the AM command transmitter and repeat steps 3 and 4.

6. Tune the command transmitters to a command frequency 10 kHz above or below that of the spacecraft under test and repeat the entire procedure.

TEST DATA

Date: ____________ Spacecraft: ____________

Test Conductor: ____________ Model: ____________

Test Facility: ____________ Spacecraft Location: ____________

SOD-NAS Rep: ____________ Spacecraft Mode: ____________

a. Test Results

Modulation		Command Frequency	Command Sent	Response	
AM	PM			Yes	No

b. Remarks

____

____

____

____

RECORDING PROCEDURE

a. Purpose

The purpose of this procedure is to obtain one or more steady-level magnetic tapes containing actual telemetry information from the spacecraft. These tapes will be used to check the spacecraft compatibility with GSFC data-handling equipment, and to conduct STADAN tape exercises.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

The steady-level magnetic tapes are produced by applying telemetry signals from the spacecraft to a receiver and then recording the receiver output.

1. Perform prepass calibration, including voice annotation, in accordance with standard procedures.
2. Adjust the input variable attenuator for a received telemetry signal of approximately -90 dbm at the input to the preamplifier.
3. Record each mode of the spacecraft telemetry for the time duration specified in the compatibility test plan.
4. Perform postpass calibration in accordance with standard procedures.
5. Complete the data sheet and attach the tape logs to the data sheets for all tapes delivered to the Network Assurance Section.

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Recorded Results

1. Block of tape numbers used______________

2. Summary of recorded data:

Spacecraft Mode	Tape Nos.	Minutes of Data
TOTAL		

b. Remarks

____

____

____

____

____

RECORDING PROCEDURE

a. Purpose

The purpose of this procedure is to obtain a variable-level magnetic tape containing the actual telemetry information from the spacecraft. This tape will be used to check the spacecraft compatibility with GSFC data-handling equipment.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

1. Perform prepass calibration, including voice annotation, in accordance with standard procedures.
2. Record the data for the period of time and at levels specified by the Network Assurance Section.
3. Perform postpass calibration in accordance with standard procedures.
4. No data sheet is provided for this test. Submit a copy of the tape log in lieu of a data sheet.

STEADY-LEVEL STRIP CHART RECORDING

RECORDING PROCEDURE

a. Purpose

The purpose of this procedure is to obtain one or more strip charts containing representative telemetry data from the spacecraft. This will be used as an aid to the stations in setting their strip chart recorders.

b. Equipment Configuration

Equipment configuration and parameter settings are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

A strip chart recording will be made for at least three frames of each type of data which the spacecraft transmits.

1. Perform prepass calibration in accordance with standard procedures.
2. Adjust the input variable attenuator for a received telemetry signal of -90 dbm at the input to the preamplifier.
3. Strip-chart the discriminator output for at least three frames of each type of data which the spacecraft transmits.
4. Perform postpass calibration in accordance with standard procedures.
5. In lieu of the data sheet, submit a properly annotated and representative strip chart.

PHOTOGRAPHIC PROCEDURE

a. Purpose

The purpose of this procedure is to provide photographs of the demodulated spacecraft baseband signal. These photographs will be used by STADAN stations for comparison with data from the actual satellite.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram.

c. Procedure

Obtain several photographs of the demodulated signal, using the following procedure:

1. Connect an oscilloscope to the diversity combiner output and set the excursions to equal approximately 2.8 volts, peak-to-peak.
2. Set time base controls to obtain a single sweep display which is representative of the spacecraft baseband signal.
3. Mount the camera and adjust the trace and graticule brightness for correct intensity.
4. Make photographs of all noticeably different types of spacecraft telemetry signals.
5. Number and label the backs of all photographs. Submit the photographs with the data sheet.

BASEBAND VIDEO PHOTOGRAPH

PHOTOGRAPHIC DATA

Date: ____________ Spacecraft: ____________

Test Conductor: ____________ Model: ____________

Test Facility: ____________ Spacecraft Location: ____________

SOD-NAS Rep: ____________ Spacecraft Mode: ____________

a. Test Results

Photo No.	Type of Data	Time Base (msec/cm)	Vertical Cal (v/cm)	Loop Bandwidth (Hz)	Video Bandwidth

b. Remarks

____

____

____

____

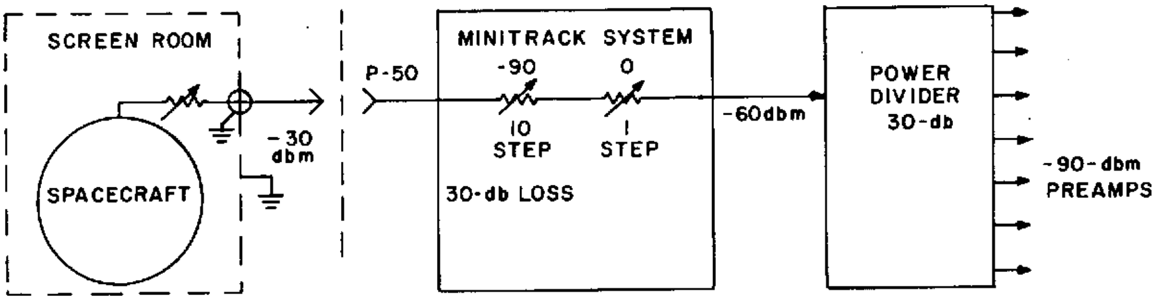
TEST DESCRIPTION

a. Purpose

The purpose of this test is to determine whether the spacecraft and the Minitrack Interferometer System are compatible, and to measure the threshold of the Minitrack System.

b. Equipment Configuration

Equipment parameters and connections are shown in the Compatibility Test Configuration Block Diagram, with the following additions:



c. Procedure

1. Change the system cabling so that the inputs to the fine and medium analog phasemeters are interchanged. Change the fine filter bandwidth to 2 Hz.

2. Set up the Minitrack system to the frequency of the transmitter and set the phase and AGC maximums and minimums on the analog recorder.

3. Run a standard Minitrack AGC calibration. Make both analog and digital recordings. Do not turn off the analog recorder until test is complete. During the precalibration and the rest of the test the analog recording must be annotated with sufficient information to permit post test analysis.

4. Set the calibrator to the following levels and record 10 lines of data at each level.

   Maximum expected ambiguity signal.
   Minimum expected ambiguity signal.
   -126 to -135 dbm in 1 db steps.

5. Set calibrator to -90 dbm. Expand ambiguity AGC display to facilitate resetting the power level with good accuracy.

6. Disconnect the calibrator output from J-50 and turn the CAL ADJUST control fully CCW. This will minimize possible interference from the calibrator.

7. Apply the spacecraft signal to J-50 at a level of approximately -30 dbm. Adjust screen room attenuator to match the AGC indication noted in step 4.

NOTE

In order to match levels, at least 95% of the signal power must be passed by the Minitrack 10-kHz IF bandwidth. This means that step 6 should be performed without modulation on the spacecraft transmitter. If this cannot be done, the test conductor must specify the mode to be used and supply a correction factor (if needed) so that the level can be properly set. That is, the total spacecraft signal power is equal to -90 dbm at the preamplifier input.

8. Using the console attenuators, set the signal level as follows. Record 10 lines of data at each level.

   Maximum expected ambiguity signal level.
   Minimum expected ambiguity signal level.
   -126 to -135 dbm in 1 db steps.

9. Return the signal level to -90 dbm, and note the ambiguity AGC.

10. Command the spacecraft into other modes as desired and repeat steps 7 and 8 for each mode.

11. Remove the spacecraft signal from J-50 and apply the calibrator signal. Set the CAL ADJUST control for a meter indication of 60.

12. Perform postcalibration in accordance with standard procedures.

13. Print out the digital record. Analyze the print-out as follows to determine the Minitrack threshold: Determine the RF level at which the medium ambiguity phase readout varies by 40 counts peak-to-peak.

14. Remove the analog recording and inspect it and the print-out for evidence of spacecraft modulation interference with the functioning of the phasemeters. Indicate on the data sheet whether or not interference was observed.

15. Determine the Minitrack threshold for each mode. Complete the data sheet.

16. Return system cabling to the normal configuration.

TEST DATA

Date: ______________ Spacecraft: ______________

Test Conductor: ______________ Model: ______________

Test Facility: ______________ Spacecraft Location: ______________

SOD-NAS Rep: ______________ Spacecraft Mode: ______________

a. Test Results

Mode	Interference	Threshold (dbm)

b. Remarks

____
Test Title

TEST DATA (Cont)

b. Remarks

APPENDIX A

COMPATIBILITY TEST CONFIGURATION BLOCK DIAGRAMS

A

APPENDIX A

COMPATIBILITY TEST CONFIGURATION BLOCK DIAGRAMS

A.1 GENERAL

The equipment configuration for compatibility testing depends on the type of spacecraft telemetry and whether the test is performed at the Network Test and Training Facility (NTTF) or at some other location.

Figures A-1, A-2, A-3, and A-4 illustrate typical equipment configurations used for compatibility testing. Figure A-1 is representative of the test configuration used at the NTTF for testing a spacecraft which employs PAM/FM/PM telemetry. Figure A-2 illustrates a typical configuration used for testing a spacecraft transmitting PCM/FM telemetry data and Figure A-3 is a typical configuration for testing a spacecraft transmitting PCM/PM telemetry data. Figure A-4 represents the STADAN Test Van equipment configuration for testing a spacecraft which has a PCM/FM/PM telemetry system.

A.2 EQUIPMENT CONSIDERATIONS

The equipment configurations presented in Figures A-1, A-2, A-3 and A-4 are basically similar; however, certain items are necessarily changed to accommodate the type of spacecraft telemetry equipment and the test location. When the spacecraft is tested at the NTTF, it is placed in a screen room to prevent spurious radiation from interfering with the station equipment. When it is tested at the manufacturer's location, using the STADAN Test Van, the spacecraft is usually placed in some type of test environment such as that in a thermal vacuum chamber.

Down-converters are necessary for conversion to the 136-MHz band if the spacecraft carrier frequency is in the 400-MHz or the 1700-MHz band. Variable attenuators, preamplifiers, and multicouplers are employed between the spacecraft and the station receiving equipment. A phase-lock demodulator or a discriminator is required, depending on whether the spacecraft carrier is phase- or frequency-modulated. Additional discriminators may be required to remove data from the subcarriers generated in the spacecraft. Band-switching or plug-in discriminators are available to remove standard IRIG subcarriers, and special equipment is supplied to discriminate nonstandard subcarriers.

Data-handling equipment is used to condition and display the telemetry data. The type of data-handling equipment used is dependent on the type of telemetry employed by the spacecraft. Although PCM telemetry is becoming more prevalent, PAM or PFM telemetry is employed on some spacecraft. STADAN stations presently have PCM decommutation capability and limited PFM decommutation capability. PAM data are usually displayed on a strip chart. In some instances, special data-handling equipment is provided by the project concerned with the spacecraft mission.

For most spacecraft projects, permanent data recordings are required. For this purpose, magnetic tape recorders and strip chart recorders are used, and photographs are taken. The magnetic tape recordings made during the compatibility test are later used by the STADAN stations for exercises simulating a live pass by the spacecraft.

Since provisions are included for testing the spacecraft command system, where applicable, a command encoder is required. Most spacecraft are compatible with the GSFC CSC command encoder, and both the NTTF and the STADAN Test Van have this command capability. In some cases, special command encoders are used and these are supplied by the project concerned.

A.3 STADAN TEST VANS

The STADAN Test Vans are mobile units containing equipment which makes them similar to a single-link telemetry station. The equipment in the van includes a log-periodic antenna, a telemetry link, command link, and supporting data display and recording equipment. The vans provide a means of testing spacecraft at remote locations for telemetry and command compatibility with STADAN equipment. These vans can be moved to a spacecraft manufacturer's plant or to a launch site for testing purposes.

A detailed description of the interface requirements for the STADAN Test Vans will be published under a separate cover.

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